



REVIEW

Unlocking the healing spectrum: a narrative review fusing insights from internal medicine, dermatology, and plastic surgery

Desbloqueando el espectro curativo: una revisión narrativa que fusiona conocimientos de medicina interna, dermatología y cirugía plástica

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ABSTRACT

Introduction: wound healing and tissue regeneration are complex processes influenced by systemic health, local wound environment, and surgical interventions. Despite advances in medical science, non-healing wounds and scarring remain significant clinical challenges.

Objective: The objective of this review is to synthesize the contributions of internal medicine, dermatology, and plastic surgery to wound healing and tissue regeneration, highlighting the importance of interdisciplinary approaches in optimizing wound care strategies and patient outcomes.

Methods: a comprehensive literature search was conducted in PubMed, Web of Science, and Scopus databases to identify relevant articles on wound healing and tissue regeneration, focusing on the contributions of internal medicine, dermatology, and plastic surgery. The review synthesizes evidence from these studies, emphasizing the importance of systemic health, skin physiology, and surgical interventions in optimizing wound healing and tissue regeneration.

Results: this review highlights the complementary roles of internal medicine, dermatology, and plastic surgery in addressing systemic health, skin physiology, and surgical interventions for wound healing and tissue regeneration. Internal medicine addresses systemic health factors that impact wound repair, dermatology focuses on skin physiology and pathology, and plastic surgery provides techniques for functional and aesthetic restoration of tissues. The review emphasizes the importance of interdisciplinary collaboration, patient-centered care, health disparities, and technological advancements in optimizing the healing spectrum.

Conclusions: unlocking the healing spectrum requires a comprehensive and interdisciplinary approach that integrates insights from internal medicine, dermatology, and plastic surgery. Addressing systemic health, skin physiology, and surgical interventions is crucial for wound healing and tissue regeneration.

Keywords: Wound Healing; Internal Medicine; Dermatology; Plastic Surgery; Interdisciplinary Approach; Patient-Centered Care.

RESUMEN

Introducción: la cicatrización de heridas y la regeneración de tejidos son procesos complejos influenciados por la salud sistémica, el entorno local de la herida y las intervenciones quirúrgicas. A pesar de los avances en la ciencia médica, las heridas que no cicatrizan y las cicatrices siguen siendo desafíos clínicos importantes.

Objetivo: el objetivo de esta revisión es sintetizar las contribuciones de la medicina interna, la dermatología y la cirugía plástica a la cicatrización de heridas y la regeneración de tejidos, destacando la importancia de los enfoques interdisciplinarios.

Métodos: se realizó una búsqueda bibliográfica exhaustiva en las bases de datos PubMed, Web of Science y Scopus para identificar artículos relevantes sobre cicatrización de heridas y regeneración de tejidos, centrándose en las contribuciones de la medicina interna, la dermatología y la cirugía plástica.

Resultados: esta revisión destaca las funciones complementarias de la medicina interna, la dermatología y la cirugía plástica para abordar la salud sistémica, la fisiología de la piel y las intervenciones quirúrgicas para la cicatrización de heridas y la regeneración de tejidos. La medicina interna aborda los factores de salud sistémicos que afectan la reparación de heridas, la dermatología se centra en la fisiología y patología de la piel y la cirugía plástica proporciona técnicas para la restauración funcional y estética de los tejidos.

Conclusiones: desbloquear el espectro curativo requiere un enfoque integral e interdisciplinario que integre conocimientos de la medicina interna, la dermatología y la cirugía plástica.

Palabras clave: Cicatrización de Heridas; Medicina Interna; Dermatología; Cirugía Plástica; Enfoque Interdisciplinario; Atención Centrada en el Paciente.

INTRODUCTION

The human body is an intricate and highly complex system that functions as a symphony of interdependent biological processes. Among these, the mechanisms underlying tissue repair and regeneration are particularly intriguing, as they play a pivotal role in maintaining health and addressing pathologic conditions.⁽¹⁾ Healing processes are orchestrated by a network of cellular interactions and molecular pathways, which are influenced by factors such as age, genetics, nutrition, and overall health. To uncover the full healing spectrum, it is imperative to look beyond the boundaries of individual medical disciplines and adopt a holistic approach.^(1,2)

In recent years, there has been an increasing recognition of the importance of interdisciplinary collaboration in advancing medical research and clinical care.⁽³⁾ Within this context, three specialties—internal medicine, dermatology, and plastic surgery—offer unique and complementary insights that can be fused to optimize healing strategies. Internal medicine brings a broad understanding of systemic health, addressing underlying conditions and optimizing the patient's overall well-being.⁽³⁾ Dermatology focuses on the skin's anatomy, physiology, and pathology, shedding light on its role as a barrier and key player in wound repair. Plastic surgery, with its emphasis on functional and aesthetic restoration, offers techniques for reconstructive and regenerative interventions.⁽⁴⁾

In this narrative review, we endeavor to combine these specialties' insights to gain a comprehensive understanding of the healing spectrum. We will also discuss the latest advances in tissue engineering, regenerative medicine, and therapeutic approaches, highlighting their potential to revolutionize clinical practice and improve patient outcomes. In doing so, we will emphasize the interdependence of systemic health and localized tissue repair, as well as the importance of a patient-centered approach that considers the individual's unique needs and circumstances.

The fusion of internal medicine, dermatology, and plastic surgery can shed light on the full spectrum of healing processes and offer innovative approaches for promoting optimal tissue repair and regeneration. By embracing an integrative and multidisciplinary perspective, we can uncover new avenues for research, refine clinical strategies, and ultimately improve the quality of life for patients experiencing various health challenges.

⁽⁵⁾ As we delve into the multifaceted world of healing, we aim to stimulate further collaboration among these specialties and contribute to the ongoing evolution of medical science and clinical practice.

METHODS

Search Strategy

We conducted a comprehensive literature search of the PubMed, Embase, and Cochrane Library databases to identify relevant studies published from 2013 to April 2023. The search was restricted to articles published in English. Search terms included combinations of the following keywords: "healing," "wound repair," "regeneration," "internal medicine," "dermatology," "plastic surgery," "tissue engineering," "inflammation," "angiogenesis," "tissue remodeling," "regenerative medicine," "therapeutic approaches," and related terms. We also reviewed

the reference lists of the identified articles for additional relevant studies.

Study Selection

We included original research articles, systematic reviews, meta-analyses, and narrative reviews that provided insights into the healing spectrum, focusing on the contributions of internal medicine, dermatology, and plastic surgery. We excluded studies that did not offer insights relevant to the specific focus of our review or had significant methodological limitations.

Data Extraction

The extracted data included study design, sample size, population characteristics, intervention details, outcomes measured, key findings, and conclusions.

Data Synthesis

We synthesized the extracted data using a narrative approach, highlighting the key insights and contributions of internal medicine, dermatology, and plastic surgery in understanding, and optimizing the healing spectrum. We discussed the complex biological processes underlying wound repair, including inflammation, angiogenesis, and tissue remodeling, as well as the advances in tissue engineering, regenerative medicine, and therapeutic approaches. We emphasized the importance of a holistic, patient-centered approach that considers the interdependence of systemic health and localized tissue repair.

Quality Assessment

We assessed the quality of the included studies using the Oxford Centre for Evidence-Based Medicine (OCEBM) Levels of Evidence,⁽⁶⁾ which categorizes studies based on their methodological rigor and potential for bias. We considered studies with higher levels of evidence to carry more weight in our analysis and synthesis.

Assessment of Evidence Strength

To assess the strength of the evidence, we used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system.⁽⁷⁾ This system evaluates the quality of evidence and the strength of recommendations based on factors such as study design, risk of bias, inconsistency, indirectness, imprecision, and other considerations. We ranked the evidence as high, moderate, low, or very low quality.

Narrative Synthesis

We synthesized the data in a narrative format, weaving together the identified themes and interdisciplinary insights. We discussed the implications of our findings for clinical practice and future research, highlighting the need for a holistic, patient-centered approach and continued collaboration among medical specialties.

Review Limitations

We acknowledge that our review has limitations, including the potential for selection bias, publication bias, and language bias. Additionally, our focus on studies published in English may have excluded relevant research published in other languages. We recognize that our narrative synthesis is based on our interpretation of the evidence and that other interpretations may be possible.

RESULTS

Contributions of Internal Medicine

Internal medicine plays a crucial role in optimizing the healing spectrum by addressing underlying systemic health conditions that may impact wound repair and tissue regeneration.⁽⁸⁾ Chronic diseases such as diabetes, hypertension, and cardiovascular disease can impair the body's ability to heal effectively. For example, diabetes can lead to poor circulation, neuropathy, and immune dysfunction, all of which can slow down the healing process.⁽⁹⁾ In such cases, internal medicine's interventions, such as blood glucose control, cardiovascular risk management, and immunomodulation, can significantly enhance the body's healing capabilities. Furthermore, internal medicine provides valuable insights into the roles of nutrition, inflammation, oxidative stress, and hormonal balance in wound healing. Nutritional interventions, anti-inflammatory agents, and hormone therapy may all play a role in promoting optimal healing.⁽¹⁰⁾

Contributions of Dermatology

Dermatology contributes to the healing spectrum by offering a deep understanding of the skin's anatomy, physiology, and pathology. The skin plays a critical role in wound repair, serving as a barrier against infection and regulating fluid balance, temperature, and sensory perception.⁽¹¹⁾ Dermatologists are experts in identifying and managing skin conditions that can impair wound healing, such as chronic ulcers, atopic dermatitis,

and psoriasis. Furthermore, dermatology provides insights into the molecular mechanisms underlying skin regeneration, including keratinocyte migration, collagen synthesis, and extracellular matrix remodeling.⁽¹²⁾ Advances in dermatological therapies, such as biologics, growth factors, and laser treatments, have the potential to enhance the body's natural healing processes and improve wound outcomes.⁽¹³⁾

Contributions of Plastic Surgery

Plastic surgery contributes to the healing spectrum by offering techniques for functional and aesthetic restoration of tissues.⁽¹⁴⁾ Plastic surgeons specialize in reconstructive and regenerative interventions that can promote wound healing, restore tissue integrity, and improve quality of life. Surgical techniques such as skin grafting, flap surgery, and microvascular anastomosis can be used to close wounds, restore blood supply, and achieve functional and cosmetic outcomes. Moreover, plastic surgery contributes to the development of tissue engineering and regenerative medicine approaches, including the use of stem cells, bioengineered skin substitutes, and 3D-printed scaffolds.⁽¹⁴⁾ These innovative therapies hold promise for enhancing wound repair and tissue regeneration in challenging cases.⁽⁴⁾

Interdisciplinary Insights and Collaboration

The fusion of insights from internal medicine, dermatology, and plastic surgery creates a comprehensive and integrative approach to the healing spectrum. By addressing systemic health, skin physiology, and surgical interventions, this interdisciplinary approach offers a holistic perspective on wound healing and tissue regeneration.⁽¹⁵⁾ Collaborative efforts among these specialties can lead to improved patient outcomes, personalized treatment plans, and the development of novel therapies.⁽¹⁶⁾ For example, a patient with a chronic diabetic foot ulcer may benefit from a multidisciplinary approach that includes blood glucose control, wound care, and surgical intervention. Such collaboration allows for the optimization of healing strategies, addressing both the underlying systemic conditions and the local wound environment.^(15,16)

Advances in Regenerative Medicine

One of the most exciting developments in the field of wound healing and tissue regeneration is the emergence of regenerative medicine, which aims to restore damaged tissues and organs to their natural function.⁽¹⁷⁾ This interdisciplinary approach integrates insights from internal medicine, dermatology, and plastic surgery, using techniques such as stem cell therapy, gene therapy, and tissue engineering. For instance, mesenchymal stem cells (MSCs) are being explored for their ability to modulate the immune response, promote angiogenesis, and facilitate wound healing. Similarly, advances in gene therapy are paving the way for targeted interventions that can enhance tissue repair at the molecular level.⁽¹⁷⁾

Microbiome Insights

Recent research has highlighted the role of the skin microbiome in wound healing and tissue regeneration.⁽¹⁸⁾ The skin is home to diverse communities of microorganisms that interact with the immune system and influence skin health. Dermatological insights into the microbiome's role in wound healing have led to the development of microbiome-targeted therapies.⁽¹⁸⁾ Probiotics, prebiotics, and microbiome transplantation are emerging as potential treatments for chronic wounds and skin disorders. Internal medicine plays a role in addressing systemic factors that can affect the skin microbiome, such as gut health, nutrition, and immune function.⁽¹⁸⁾

Telemedicine and Digital Health

The integration of telemedicine and digital health technologies into wound care has the potential to revolutionize the healing spectrum. Internal medicine, dermatology, and plastic surgery can all benefit from these technologies, allowing for remote patient monitoring, early detection of complications, and timely interventions. Wearable sensors, smart dressings, and mobile apps can provide real-time data on wound healing progress, enabling personalized treatment plans and optimizing patient outcomes. Digital health platforms can also facilitate interdisciplinary collaboration among healthcare professionals, fostering a holistic approach to wound healing and tissue regeneration.^(19,20)

Future Directions

The continued integration of internal medicine, dermatology, and plastic surgery insights into the healing spectrum is essential for advancing the field of wound healing and tissue regeneration. Research should focus on exploring the roles of genetics, epigenetics, and immunology in wound healing, as well as investigating the potential of regenerative medicine, microbiome-targeted therapies, telemedicine, and personalized medicine. Additionally, interdisciplinary collaboration among healthcare professionals is crucial for optimizing healing strategies, addressing both systemic and local factors, and improving patient outcomes. As we continue to unlock the healing spectrum, we must prioritize a holistic, patient-centered approach that considers the

complex interplay of biological, environmental, and lifestyle factors.⁽²¹⁾

Table 1. Contributions of internal medicine, dermatology, and plastic surgery to the healing spectrum, including relevant advances and innovations

Specialty	Contributions	Key Advances & Innovations
Internal Medicine	- Addressing underlying systemic health conditions impacting wound repair - Optimizing nutrition, inflammation, oxidative stress, and hormonal balance	- Blood glucose control in diabetes - Cardiovascular risk management - Nutritional interventions - Anti-inflammatory agents - Hormone therapy
Dermatology	- Understanding skin anatomy, physiology, and pathology - Identifying and managing skin conditions impairing wound healing - Understanding molecular mechanisms underlying skin regeneration	- Biologics for skin conditions - Growth factors for wound healing - Laser treatments for wound repair - Microbiome-targeted therapies (probiotics, prebiotics, microbiome transplantation)
Plastic Surgery	- Providing techniques for functional and aesthetic restoration of tissues - Reconstructive and regenerative interventions for wound healing and tissue integrity	- Skin grafting and flap surgery - Microvascular anastomosis - Tissue engineering (stem cells, bioengineered skin substitutes, 3D-printed scaffolds) - Regenerative medicine approaches (stem cell therapy, gene therapy)
Interdisciplinary Insights	- Integrating insights from internal medicine, dermatology, and plastic surgery - Addressing systemic health, skin physiology, and surgical interventions	- Telemedicine and digital health technologies (remote patient monitoring, smart dressings, mobile apps) - Personalized medicine (genetic testing, pharmacogenomics, biomarker analysis)
Source: review data		

Table 2. Key challenges associated with wound healing and tissue regeneration, along with potential solutions that can be provided by internal medicine, dermatology, and plastic surgery

Challenge	Internal Medicine Solutions	Dermatology Solutions	Plastic Surgery Solutions
Chronic systemic diseases (e.g., diabetes, cardiovascular disease)	- Blood glucose control - Cardiovascular risk management - Immunomodulation	- Management of skin manifestations associated with chronic diseases - Identification of skin conditions exacerbated by systemic diseases	- Surgical interventions tailored to the specific needs of patients with chronic diseases - Flap surgery for improved blood supply
Infection risk	- Systemic antibiotic therapy - Immunotherapy to boost immune response	- Topical antibiotic therapy - Antiseptic treatments	- Debridement of infected tissue - Grafts with antimicrobial properties
Poor vascularization	- Treatment of peripheral artery disease - Smoking cessation counseling	- Topical vasodilators - Growth factor application	- Microvascular anastomosis - Flap surgery to improve blood supply
Non-healing ulcers	- Nutritional support - Compression therapy	- Wound dressings to maintain moisture - Biologics to reduce inflammation	- Skin grafts - Vacuum-assisted closure
Scarring and fibrosis	- Anti-inflammatory medications - Hormone therapy to reduce fibrosis	- Laser therapy for scar remodeling - Corticosteroid injections	- Scar revision surgery - Tissue expanders

Chronic pain	- Pain management medications - Integrative therapies (e.g., acupuncture)	- Topical anesthetics - Treatment of underlying skin conditions causing pain	- Nerve decompression surgery - Surgical removal of painful lesions
Source: review data			

DISCUSSION

The contributions of internal medicine, dermatology, and plastic surgery to the healing spectrum are multifaceted and intricate, encompassing a broad range of therapies and interventions to optimize wound healing and tissue regeneration. This narrative review has highlighted the complementary roles of these specialties in addressing systemic health, skin physiology, and surgical interventions. By integrating insights from these disciplines, we can develop comprehensive and interdisciplinary approaches to wound care, fostering a holistic perspective that encompasses both the underlying systemic conditions and the local wound environment.⁽¹⁶⁾

A key theme emerging from this review is the importance of addressing chronic systemic diseases, such as diabetes and cardiovascular disease, in optimizing wound repair and tissue regeneration. The evidence suggests that systemic health plays a crucial role in determining wound healing outcomes. Addressing underlying systemic conditions can improve wound repair, reduce complications, and enhance patient quality of life. The contributions of internal medicine are invaluable in managing these systemic health factors.⁽²²⁾

Another important theme is the role of the skin microbiome in wound healing and tissue regeneration. The skin is colonized by diverse communities of microorganisms that interact with the immune system and influence skin health. Disruptions in the skin microbiome have been implicated in skin conditions that impair wound healing, such as chronic ulcers, atopic dermatitis, and psoriasis. Dermatology's insights into the skin microbiome's role in wound healing offer novel treatment approaches, including microbiome-targeted therapies.⁽¹⁸⁾

Furthermore, the review has emphasized the contributions of plastic surgery to functional and aesthetic restoration of tissues. Plastic surgeons specialize in reconstructive and regenerative interventions that promote wound healing and restore tissue integrity. Surgical techniques such as skin grafting, flap surgery, and microvascular anastomosis can be used to close wounds, restore blood supply, and achieve functional and cosmetic outcomes. The advent of tissue engineering and regenerative medicine approaches offers exciting prospects for enhancing wound repair and tissue regeneration.⁽⁴⁾

The integration of telemedicine and digital health technologies into wound care represents a promising avenue for optimizing the healing spectrum. These technologies facilitate remote patient monitoring, early detection of complications, and timely interventions. Additionally, personalized medicine approaches, such as genetic testing and pharmacogenomics, can enhance wound healing and tissue regeneration strategies by tailoring treatments to the individual patient's unique genetic, environmental, and lifestyle factors.⁽¹⁹⁾

It is important to note that interdisciplinary collaboration among healthcare professionals is crucial for optimizing healing strategies, addressing both systemic and local factors, and improving patient outcomes. The integration of internal medicine, dermatology, and plastic surgery insights into the healing spectrum can foster a holistic, patient-centered approach that considers the complex interplay of biological, environmental, and lifestyle factors.

Patient-Centered Care

Patient-centered care is a critical component of optimizing wound healing and tissue regeneration. Understanding the individual needs and preferences of patients is crucial for tailoring interventions and ensuring adherence to treatment plans. By incorporating insights from internal medicine, dermatology, and plastic surgery, healthcare professionals can create personalized treatment plans that consider the patient's systemic health, skin physiology, and aesthetic and functional goals. Effective communication and shared decision-making between healthcare providers and patients are essential for achieving optimal outcomes.⁽²³⁾

Addressing Health Disparities

Health disparities, including socioeconomic, racial, and geographic disparities, can significantly impact wound healing and tissue regeneration outcomes. Access to healthcare services, quality of care, and patient education can vary across different populations. Efforts to reduce health disparities are essential for ensuring equitable access to wound care services and improving patient outcomes. Interdisciplinary approaches can help address these disparities by integrating internal medicine, dermatology, and plastic surgery insights to provide comprehensive care for diverse populations. Strategies may include community outreach, patient education, and targeted interventions for underserved communities.⁽²¹⁾

CONCLUSIONS

The healing spectrum's optimization is a multifaceted endeavor that necessitates a comprehensive and

interdisciplinary approach. This review highlights the significant contributions of internal medicine, dermatology, and plastic surgery in addressing systemic health, skin physiology, and surgical interventions for wound healing and tissue regeneration. Integrating insights from these specialties, along with multidisciplinary collaboration and patient-centered care, can greatly enhance wound care strategies and improve patient outcomes. The growing body of research in areas such as regenerative medicine, microbiome-targeted therapies, telemedicine, personalized medicine, and health disparities underscores the need for continued exploration and innovation in the field of wound healing and tissue regeneration.

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