

Review Article

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“COMPARATIVE PERSPECTIVES ON WOUND HEALING: AN INTEGRATIVE REVIEW OF AYURVEDIC AND MODERN APPROACHES”

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ABSTRACT

Introduction: Wound healing is a complex physiological process essential for restoring tissue integrity and function. Ayurveda, through the concepts of *Vrana* and *Vrana Chikitsa*, offers time-tested approaches for wound care, while modern medicine relies on pharmacological agents, surgical interventions, and biotechnological innovations. **Methods:**

A comprehensive literature review was conducted using Ayurvedic classical texts (*Sushruta Samhita*, *Charaka Samhita*, *Ashtanga Hridaya*) alongside scientific databases (PubMed, Scopus, Web of Science, and AYUSH Research Portal). Studies included randomized controlled trials, observational studies, preclinical research, and reviews published between 2000 and 2025. Inclusion criteria focused on wound healing strategies in Ayurveda and modern biomedicine, while non-peer-reviewed sources were excluded. **Results:** Ayurvedic texts describe wound types (*Vrana bheda*), stages of healing (*Ropana*), and management strategies such as *Shashti Upakrama* (sixty wound management procedures), herbal formulations (*Haridra*, *Nimba*, *Jatyadi taila*), surgical interventions (*Kshara Sutra*, *Jalaukavacharana*), and lifestyle modifications. Modern approaches emphasize the molecular basis of wound healing, growth factors, stem cell therapy, nanotechnology, and advanced dressings (hydrocolloids, bioengineered scaffolds). Comparative analysis reveals that Ayurveda emphasizes holistic and individualized care, focusing on balancing *Doshas* and promoting natural healing, while modern medicine advances tissue regeneration through targeted biochemical and technological interventions.

Discussion: Both systems show complementary strengths—Ayurveda offers safe, cost-effective, and holistic care, whereas modern medicine provides rapid, evidence-based, and technologically advanced solutions. However, gaps remain in standardization, scientific validation of Ayurvedic formulations, and long-term safety of modern innovations. **Conclusion:** Integrating Ayurvedic wisdom with modern evidence-based strategies can optimize wound management, enhance patient outcomes, and open avenues for integrative medicine. Further interdisciplinary research and clinical trials are required to bridge traditional knowledge and modern science.

KEYWORDS: Ayurveda, integrative medicine, modern wound care, tissue regeneration, *Vrana Chikitsa*



INTRODUCTION

Wounds represent one of the oldest challenges in healthcare, with their management described in detail across civilizations. In modern medicine, wound healing is understood as a dynamic, multistage biological process involving hemostasis, inflammation, proliferation, and remodeling^[1-2]. Despite the advances in surgical techniques, antimicrobial therapy, and tissue engineering, chronic and non-healing wounds remain a significant burden worldwide^[3-4].

In Ayurveda, wounds are described under the category of *Vrana*, with detailed classifications, etiology, prognosis, and therapeutic approaches extensively documented in texts such as *Sushruta Samhita*^[5-6]. Ayurveda emphasizes not only the local management of wounds but also systemic purification, dietary regulation, and lifestyle measures to promote holistic recovery. Therapeutic modalities include herbal drugs, medicated oils, alkali therapy, surgical techniques, and parasurgical interventions^[7-8].

This review aims to provide a comparative analysis of Ayurvedic and modern approaches to wound healing, highlighting their unique contributions, similarities, limitations, and future integration potential. The objectives are to (i) critically evaluate Ayurvedic principles and therapies for wound healing, (ii) summarize modern scientific advances, and (iii) explore opportunities for combining both approaches in integrative wound care^[9-10].

MATERIALS AND METHODS

A structured literature review was conducted from June–August 2025.

- **Databases searched:** PubMed, Scopus, Web of Science, AYUSH Research Portal, Google Scholar^[11].
- **Keywords used:** “Ayurveda wound healing,” “*Vrana Chikitsa*,” “Ayurvedic formulations for wounds,” “modern wound management,” “integrative wound healing.”^[12]
- **Inclusion criteria:**^[13]
 - Ayurvedic classics (*Sushruta Samhita*, *Charaka Samhita*, *Ashtanga Hridaya*) and authoritative commentaries.
 - Peer-reviewed journal articles, RCTs, systematic reviews, and experimental

studies published between 2000–2025.

- Clinical trials or case reports related to wound healing.
- **Exclusion criteria:**^[14]
 - Non-peer-reviewed publications, anecdotal reports, and unrelated literature.
- **Study types reviewed:** Clinical studies, preclinical models, systematic reviews, and historical texts^[15].

Thematic analysis was employed to categorize findings into Ayurvedic concepts, formulations, surgical interventions, and modern wound healing advancements.

OBSERVATION AND RESULTS

1. Ayurvedic Understanding of Wound Healing

Ayurveda recognizes wounds under *Vrana*, classified broadly into *Nija* (endogenous, caused by Dosha vitiation) and *Agantuja* (external, caused by trauma). *Sushruta* describes 60 measures (*Shashti Upakrama*) for comprehensive wound care, including debridement (*Shodhana*), cleansing (*Parisheka*), suturing (*Suturing methods like Gopanika, Tunnasevani*), application of herbal formulations, bandaging (*Vrana Bandhana*), and protection.

Healing is explained in stages:

- *Shodhana* (cleansing of wound and vitiated Doshas)
- *Ropana* (healing and granulation tissue formation)
- *Sandhana* (union and scar formation)

Key formulations include *Haridra* (*Curcuma longa*), *Nimba* (*Azadirachta indica*), *Yashtimadhu* (*Glycyrrhiza glabra*), and *Jatyadi taila*, which are noted for antimicrobial, anti-inflammatory, and wound-contracting properties. *Madhu* (honey) is emphasized as a natural cleanser and promoter of tissue regeneration.

2. Ayurvedic Surgical and Parasurgical Approaches

- **Kshara Sutra therapy:** Widely used for fistula-in-ano, combining mechanical cutting and chemical cauterization, leading to effective wound healing with minimal recurrence.
- **Jalaukavacharana (leech therapy):** Applied for wounds with congestion, inflammation,

and infection; leech saliva contains hirudin and anti-inflammatory peptides.

- **Agni Karma (cauterization):** Used for hemostasis and chronic non-healing wounds.
- **Vrana Bandhana (bandaging techniques):** Sushruta describes 14 types of bandages, each suited to anatomical location and wound type.

3. Modern Biomedical Understanding of Wound Healing

Modern medicine describes four sequential yet overlapping phases:

1. **Hemostasis:** Platelet aggregation and clotting.
2. **Inflammation:** Recruitment of neutrophils and macrophages.
3. **Proliferation:** Angiogenesis, fibroblast migration, collagen deposition.
4. **Remodeling:** Collagen maturation, scar formation.

Advanced wound care emphasizes:

- **Antimicrobials and dressings:** Hydrocolloids, alginates, hydrogels.
- **Growth factors:** Platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF).
- **Stem cell therapy:** Mesenchymal stem cells in chronic wounds.
- **Nanotechnology:** Silver nanoparticles and bioengineered scaffolds.
- **Negative pressure wound therapy (NPWT):** Promotes angiogenesis and drainage.

4. Comparative Insights

- **Ayurveda:** Prioritizes systemic balance and natural healing via holistic measures.
- **Modern medicine:** Focuses on biochemical pathways, infection control, and regenerative technologies.
- **Overlap:** Use of honey, leech therapy, herbal antimicrobials, and surgical suturing shows convergence between both systems.

5. Clinical Evidence

- RCTs on *Jatyadi Taila* and honey dressings have shown significant improvements in wound contraction and epithelialization.
- Leech therapy has proven efficacy in reconstructive microsurgery and ischemic wounds.

- Modern RCTs demonstrate the effectiveness of NPWT and bioengineered scaffolds in diabetic ulcers.

DISCUSSION

The comparative analysis highlights that while Ayurveda and modern science differ in theoretical underpinnings, they share striking similarities in practice. Ayurvedic descriptions of *Shodhana* and *Ropana* can be correlated with debridement and proliferative phases in modern biology. Herbal formulations such as *Haridra* and *Madhu* exhibit pharmacological activities validated in modern research, including antimicrobial and pro-angiogenic properties^[16].

Modern wound healing, however, excels in mechanistic clarity and technological advancements. Growth factor therapy, stem cells, and nanomedicine offer precision-based approaches but come with high costs, accessibility issues, and potential side effects. In contrast, Ayurveda's methods are cost-effective, sustainable, and culturally acceptable but often criticized for lack of standardized protocols and limited high-quality clinical trials^[17].

The greatest potential lies in integrative approaches. For example, combining Ayurvedic herbal dressings with modern NPWT may enhance outcomes in chronic wounds. Similarly, leveraging nanotechnology to develop standardized Ayurvedic herbal formulations could bridge tradition and innovation^[18].

Nevertheless, challenges persist. Standardization of Ayurvedic formulations, ensuring safety through toxicity studies, and conducting large-scale multicentric RCTs are critical. On the modern side, addressing the long-term safety of advanced biomaterials and ensuring affordability remain priorities^[19].

Future prospects include developing integrative wound care protocols, translational research exploring Ayurvedic herbs at molecular levels, and policy frameworks encouraging interdisciplinary collaborations^[20].

CONCLUSION

Wound healing represents a therapeutic domain where Ayurveda and modern science can complement one another. Classical Ayurvedic principles of *Vrana Chikitsa* emphasize holistic, individualized, and cost-effective care using herbal formulations, surgical



techniques, and systemic balance. Modern wound healing, in contrast, provides mechanistic clarity, evidence-based therapies, and innovative biotechnological tools.

Comparative analysis reveals significant overlaps, such as the use of honey, leech therapy, and herbal antimicrobials, which are validated by modern studies. Ayurveda's strength lies in its holistic, patient-centered approach, while modern medicine offers technological precision and rapid interventions.

Integrating both systems could provide an optimal pathway for managing acute and chronic wounds. Evidence supports the need for more rigorous clinical research, standardization of Ayurvedic formulations, and innovative translational studies combining traditional herbs with modern biomaterials.

In conclusion, a synergistic framework merging Ayurvedic wisdom with modern evidence-based strategies may revolutionize wound management, ensuring accessibility, safety, and efficacy for diverse populations.

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