

Wound Healing (Vrana Ropana) In Ayurveda: A Review of Classical and Contemporary Evidence

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Abstract—Wound healing (Vrana Ropana) is one of the most significant therapeutic concepts described in Ayurveda, emphasizing the restoration of normal tissue structure and function through a holistic approach. Ancient Ayurvedic texts, including the *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridaya*, provide comprehensive descriptions of the etiology, classification, pathogenesis, and management of *Vrana*. Among these, *Sushruta* is regarded as the pioneer of surgery and wound management due to his detailed explanation of wound care principles, surgical techniques, debridement, bandaging methods, and sixty measures (*Shashti Upakrama*) for effective wound treatment. Ayurveda advocates individualized management based on *Dosha*, *Dhatu*, *Agni*, and the patient's overall constitution, employing internal medications, external applications, purification procedures, and dietary as well as lifestyle modifications to promote optimal healing. Numerous medicinal plants such as *Haridra* (*Curcuma longa*), *Nimba* (*Azadirachta indica*), *Jatyadi Taila*, *Madhu* (honey), and *Ghrita* have demonstrated antimicrobial, anti-inflammatory, antioxidant, and collagen-promoting properties that support tissue regeneration. Contemporary pharmacological and clinical studies have validated many of these traditional practices by demonstrating accelerated wound contraction, enhanced epithelialization, reduced microbial load, and improved collagen synthesis. Increasing interest in integrative medicine has further highlighted the relevance of Ayurvedic wound management as a safe, cost-effective, and evidence-supported therapeutic option for acute and chronic wounds. This review critically examines the classical Ayurvedic principles of *Vrana Ropana* alongside contemporary scientific evidence, emphasizing their mechanisms of action, therapeutic applications, and clinical relevance. Integrating traditional Ayurvedic

wisdom with modern biomedical research may contribute to the development of comprehensive, patient-centered wound care strategies and provide new directions for evidence-based integrative healthcare.

Index Terms—Ayurveda, Vrana, Vrana Ropana, Wound Healing, Sushruta, Shashti Upakrama, Jatyadi Taila, Madhu, Herbal Medicine, Integrative Medicine.

I. INTRODUCTION

Wound healing is a complex physiological process that restores the anatomical continuity and functional integrity of damaged tissues. It involves a coordinated sequence of hemostasis, inflammation, proliferation, angiogenesis, collagen synthesis, epithelialization, and tissue remodeling. Although advances in surgery, antibiotics, and wound dressings have significantly improved clinical outcomes, chronic wounds, diabetic ulcers, pressure sores, burns, and infected wounds continue to pose a considerable challenge worldwide due to delayed healing, microbial resistance, and high healthcare costs.¹⁻³

Ayurveda, the ancient Indian system of medicine, offers a comprehensive and holistic approach to wound management under the concept of *Vrana Ropana*. The term *Vrana* refers to the discontinuity or destruction of body tissues, whereas *Ropana* denotes the restoration and healing of these tissues. The science of wound management has been elaborately described by Acharya Sushruta, who is universally regarded as the Father of Surgery because of his pioneering contributions to surgical science and

reconstructive procedures. His detailed descriptions of wound classification, surgical instruments, debridement techniques, suturing methods, bandaging, and postoperative wound care remain remarkable even by modern standards.⁴⁻⁶

The management of wounds in Ayurveda extends beyond local treatment. Healing is considered a systemic process influenced by Dosha, Dhatu, Mala, Agni, Srotas, nutritional status, immunity (*Vyadhikshamatva*), and the overall health of the patient. Therefore, treatment includes purification procedures (*Shodhana*), healing therapies (*Ropana*), internal herbal medications, local applications, dietary regulation (*Pathya*), and lifestyle modifications to restore physiological balance and promote tissue regeneration.⁷⁻⁹

Recent scientific investigations have demonstrated that several Ayurvedic medicinal plants and formulations possess antimicrobial, anti-inflammatory, antioxidant, analgesic, collagen-enhancing, angiogenic, and immunomodulatory properties, supporting many of the principles described in classical Ayurvedic texts. Consequently, integrative wound care that combines traditional Ayurvedic knowledge with modern biomedical science is gaining increasing recognition as an effective and economical therapeutic approach.¹⁰⁻¹²

This review aims to critically analyze the classical concepts of Vrana Ropana, correlate them with contemporary understanding of wound healing, and summarize the available scientific evidence supporting Ayurvedic wound management.

II. CONCEPT OF VRANA IN AYURVEDA

The term Vrana has been derived from the Sanskrit root "*Vran*" meaning injury, rupture, or destruction of body tissues. According to Acharya Sushruta, a Vrana is defined as a disruption in the normal continuity of skin, muscles, blood vessels, ligaments, or deeper tissues, which ultimately heals by leaving a scar (*Vrana Vastu*). This definition remarkably resembles the modern concept of a wound, which is described as a break in the anatomical continuity of tissues.¹³ Acharya Charaka also described Vrana as tissue damage caused by internal or external etiological factors and emphasized that proper management restores normal structure and function. The Ayurvedic concept encompasses both physical and physiological

aspects of healing rather than merely closing the wound surface.¹⁴

According to Ayurveda, successful wound healing depends upon maintaining equilibrium of the Tridosha. Aggravation of Vata causes severe pain, dryness, delayed healing, and tissue degeneration. Increased Pitta produces inflammation, burning sensation, suppuration, discoloration, and excessive exudate. Predominance of Kapha results in swelling, heaviness, itching, excessive granulation tissue, and delayed wound contraction. Hence, treatment should always be individualized according to the predominant Dosha involved.¹⁵

Classification of Vrana

Ayurvedic classics classify wounds in several ways to facilitate appropriate diagnosis and treatment.

Based on Etiology

Acharya Sushruta broadly classified wounds into two major categories:

1. Nija Vrana (Endogenous wounds):

These wounds develop due to internal vitiation of Doshas and systemic diseases affecting tissue metabolism and immunity. Conditions such as diabetes, vascular disorders, nutritional deficiencies, and chronic inflammatory diseases can be correlated with Nija Vrana in modern medicine.¹⁶

2. Agantuja Vrana (Exogenous wounds):

These wounds result from trauma, accidental injuries, burns, bites, surgical procedures, fractures, and penetrating objects. If not managed appropriately, Agantuja wounds may subsequently become complicated by Dosha vitiation and transform into chronic wounds.¹⁷

Based on Dosha Predominance

Ayurveda further classifies wounds according to the predominance of Doshas.

Vataja Vrana

Characterized by severe pain, blackish discoloration, dryness, irregular margins, minimal discharge, delayed granulation, and slow healing.

Pittaja Vrana

Associated with redness, heat, burning sensation, yellowish discharge, foul smell, inflammation, and rapid suppuration.

Kaphaja Vrana

Exhibits pale appearance, excessive swelling, itching, coldness, profuse discharge, and sluggish healing.

Sannipataja Vrana

Represents involvement of all three Doshas and usually has the poorest prognosis due to complex pathology.

Raktaja Vrana

Predominantly involves vitiated blood and is characterized by profuse bleeding, bright red discoloration, tenderness, and inflammation.

This Dosha-based classification demonstrates Ayurveda's personalized approach to wound management and closely parallels modern concepts of inflammatory response and wound pathology.¹⁸

Causes (Nidana) of Vrana

Ayurvedic literature describes numerous causative factors responsible for wound formation.

External Causes

- Trauma
- Sharp weapons
- Burns
- Animal and insect bites
- Surgical injuries
- Foreign bodies
- Fractures
- Poisonous substances

Internal Causes

- Dosha imbalance
- Diabetes (*Prameha*)
- Malnutrition
- Poor digestion (*Mandagni*)
- Impaired immunity
- Blood disorders
- Chronic systemic diseases

Lifestyle factors such as unhealthy dietary habits, excessive physical exertion, sleep disturbances, alcoholism, smoking, psychological stress, and poor hygiene further delay the healing process by impairing tissue regeneration and immune function. Modern clinical studies similarly identify diabetes mellitus, vascular insufficiency, obesity, infection, smoking, malnutrition, and aging as important risk factors for delayed wound healing, illustrating a remarkable similarity between Ayurvedic and contemporary concepts.¹⁹⁻²¹

Pathogenesis (Samprapti) of Vrana

According to Ayurveda, wound healing begins with the aggravation of Doshas due to various etiological factors. These aggravated Doshas circulate through the

body and localize at the site of tissue injury where they vitiate Rakta, Mamsa, Meda, and other Dhatus. Obstruction of Srotas impairs nutrient supply, resulting in inflammation, pain, swelling, discharge, tissue destruction, and delayed healing.

Healing is achieved by correcting Dosha imbalance, removing necrotic tissue, improving local circulation, promoting healthy granulation, preventing infection, and restoring tissue integrity. This concept closely resembles the modern understanding of inflammatory mediators, angiogenesis, extracellular matrix synthesis, fibroblast proliferation, collagen deposition, and tissue remodeling.²²

Importance of Acharya Sushruta in Wound Healing

Among all Ayurvedic scholars, Acharya Sushruta occupies a unique position in the history of surgery. His contribution to wound management is unparalleled and continues to inspire modern surgical practice.

Sushruta described:

- Detailed wound examination
- Principles of asepsis
- Surgical debridement
- Hemostasis
- Suturing techniques
- Fracture management
- Plastic and reconstructive surgery
- Skin grafting concepts
- Bandaging techniques
- Sixty therapeutic procedures (*Shashti Upakrama*)

He emphasized that successful healing depends not only on medicines but also on meticulous wound cleaning, removal of unhealthy tissue, appropriate dressing, adequate nutrition, and proper postoperative care. Many of these principles remain fundamental to modern wound management.²³⁻²⁵

Modern Stages of Wound Healing and Their Correlation with Ayurveda

Wound healing is a dynamic and highly regulated biological process that involves the coordinated interaction of inflammatory cells, cytokines, growth factors, fibroblasts, endothelial cells, and extracellular matrix proteins. Modern medicine divides wound healing into four overlapping phases: haemostasis, inflammation, proliferation, and remodelling. Interestingly, these phases closely resemble the principles of Shodhana and Ropana described in Ayurvedic classics.²⁶

Haemostasis Phase

Immediately after tissue injury, blood vessels constrict to reduce blood loss. Platelet aggregation occurs at the injured site, resulting in clot formation. Platelets release several growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF- β), and vascular endothelial growth factor (VEGF), which initiate tissue repair.²⁷

Ayurveda recognizes the importance of controlling bleeding (*Rakta Sthapana*) and protecting the wound from contamination. Sushruta emphasized immediate haemostasis, cleansing of the wound, and appropriate bandaging as essential measures for successful healing.

Inflammatory Phase

The inflammatory phase usually lasts for three to five days. Neutrophils are the first inflammatory cells to migrate to the wound site, followed by macrophages, which remove bacteria, necrotic tissue, and cellular debris through phagocytosis. These cells also release cytokines that stimulate fibroblast proliferation and angiogenesis.²⁸

This stage closely resembles the Ayurvedic concept of Vrana Shodhana, where purification of the wound is achieved by removing slough, controlling infection, reducing inflammation, and restoring Doshic balance. Herbal formulations possessing antimicrobial, anti-inflammatory, and detoxifying properties are commonly employed during this phase.

Proliferative Phase

The proliferative phase is characterized by fibroblast migration, collagen synthesis, angiogenesis, granulation tissue formation, epithelialization, and wound contraction. Healthy granulation tissue gradually replaces the damaged tissue and restores structural continuity.²⁹

Ayurveda describes this stage as Vrana Ropana, in which various medicated oils, ghee preparations, herbal pastes, and internal medicines promote tissue regeneration, collagen deposition, and epithelial healing.

Remodelling Phase

The final stage may continue for several months. Type III collagen is gradually replaced by stronger Type I collagen, resulting in increased tensile strength and scar maturation. Although complete healing restores

tissue continuity, the repaired tissue rarely regains the full strength of uninjured skin.³⁰

The Ayurvedic concept of complete Ropana similarly refers to restoration of normal tissue integrity with minimal deformity and optimum functional recovery.

Principles of Vrana Ropana Chikitsa

The primary objective of Ayurvedic wound management is not merely wound closure but restoration of normal tissue physiology. Treatment is individualized according to the patient's Prakriti, Dosha predominance, wound characteristics, and stage of healing.³¹

The major principles include:

- Elimination of necrotic tissue
- Prevention and control of infection
- Reduction of inflammation
- Promotion of healthy granulation tissue
- Enhancement of collagen synthesis
- Maintenance of adequate local blood supply
- Nutritional support
- Prevention of recurrence
- Restoration of tissue function

Internal medicines improve digestion (*Agni*), nourish body tissues (*Dhatu Poshana*), and enhance immunity (*Vyadhikshamatva*), while external therapies accelerate local tissue repair.

Shashti Upakrama (Sixty Therapeutic Measures)

One of the greatest contributions of Acharya Sushruta to surgery is the description of Shashti Upakrama, sixty therapeutic procedures for wound management.³² These procedures represent a systematic protocol that can be selected according to the condition and stage of the wound.

Important procedures include:

- Apatarpana (lightening therapy)
- Santarpana (nourishing therapy)
- Parisheka (medicated irrigation)
- Abhyanga (oil massage)
- Swedana (fomentation)
- Vimlapana (gentle massage)
- Upanaha (medicated poultice)
- Pachana (suppuration therapy)
- Visravana (drainage)
- Shodhana (purification)
- Ropana (healing therapy)

- Bandhana (bandaging)
- Lekhana (scraping)
- Chedana (excision)
- Bhedana (incision)
- Darana (splitting)
- Eshana (probing)
- Aharana (foreign body removal)
- Seevana (suturing)
- Sandhana (union of tissues)

Many of these procedures closely correspond to modern principles of wound irrigation, debridement, incision and drainage, foreign body removal, suturing, skin approximation, wound dressing, and postoperative care.

Important Ayurvedic Drugs Used in Vrana Ropana

Numerous medicinal plants described in Ayurveda possess scientifically validated wound-healing properties.

Haridra (*Curcuma longa*)

Haridra contains curcumin, which possesses potent antioxidant, anti-inflammatory, antimicrobial, and collagen-stimulating activities. Experimental studies have demonstrated accelerated epithelialization, increased collagen deposition, and improved tensile strength following topical application.³³

Nimba (*Azadirachta indica*)

Neem exhibits broad-spectrum antibacterial, antifungal, antiviral, and anti-inflammatory activities. It is extensively used in infected wounds and chronic ulcers due to its ability to reduce microbial load and promote granulation tissue formation.³⁴

Madhu (Honey)

Honey has been described by Sushruta as an excellent cleansing (*Shodhana*) and healing (*Ropana*) agent. Modern research confirms its antibacterial activity, osmotic effect, antioxidant property, and ability to accelerate epithelialization while reducing wound odour and infection.³⁵

Ghrita

Medicated ghee preparations provide a moist healing environment, reduce inflammation, and facilitate collagen maturation. Ghrita also acts as an effective carrier for lipid-soluble phytoconstituents present in herbal formulations.³⁶

Jatyadi Taila

Jatyadi Taila is among the most widely prescribed Ayurvedic formulations for wound healing. It contains herbs such as Jati, Nimba, Haridra, Daruharidra,

Patola, and Manjistha. Clinical studies have demonstrated its efficacy in chronic ulcers, postoperative wounds, burns, diabetic ulcers, and non-healing wounds.³⁷

Yashtimadhu (*Glycyrrhiza glabra*)

Yashtimadhu possesses anti-inflammatory, antioxidant, antimicrobial, and tissue regenerative activities. Glycyrrhizin has been shown to reduce inflammatory mediators while promoting fibroblast proliferation and epithelial repair.³⁸

Contemporary Scientific Evidence

During the last two decades, increasing scientific research has validated several Ayurvedic wound-healing formulations.

Experimental animal studies have shown that *Curcuma longa*, *Centella asiatica*, *Azadirachta indica*, *Aloe vera*, and *Glycyrrhiza glabra* significantly enhance collagen synthesis, angiogenesis, wound contraction, epithelialization, and tensile strength.³⁹

Clinical trials have demonstrated encouraging results with Jatyadi Taila, Panchavalka Kwatha, Madhu, and medicated Ghrita preparations in chronic ulcers, diabetic foot ulcers, pressure sores, burns, fissures, and postoperative wounds. These formulations effectively reduce bacterial contamination, accelerate granulation tissue formation, shorten healing time, and improve patient comfort with minimal adverse effects.⁴⁰

Modern pharmacological investigations have further revealed multiple mechanisms responsible for their efficacy, including inhibition of pro-inflammatory cytokines, stimulation of fibroblast proliferation, antioxidant activity, modulation of collagen metabolism, enhanced vascularization, and improved extracellular matrix remodelling.⁴¹

These findings provide strong scientific support for integrating Ayurvedic wound management into contemporary clinical practice.

III. DISCUSSION

Ayurveda provides one of the oldest and most comprehensive descriptions of wound healing available in medical literature. Long before the discovery of microorganisms, antisepsis, or antibiotics, Acharya Sushruta emphasized wound cleansing, removal of unhealthy tissue, drainage, haemostasis, proper bandaging, nutritional support, and postoperative care. These principles remarkably parallel modern surgical practice.

Unlike the conventional approach, which primarily focuses on local wound treatment, Ayurveda considers wound healing as a systemic physiological process influenced by digestion, metabolism, immunity, tissue nutrition, mental health, and lifestyle. Consequently, Ayurvedic treatment combines local therapies with internal medicines, dietary regulation, and behavioural modifications. The growing body of experimental and clinical evidence further validates the pharmacological actions of several Ayurvedic herbs. Their antimicrobial, antioxidant, anti-inflammatory, angiogenic, immunomodulatory, and collagen-promoting properties explain many of the therapeutic effects described in classical texts.

Nevertheless, despite promising findings, larger multicentric randomized controlled clinical trials with standardized formulations and robust methodologies are required to strengthen the evidence base. Scientific standardization, quality control, pharmacovigilance, and molecular research should be encouraged to facilitate wider acceptance of Ayurvedic wound management in integrative healthcare systems.⁴²

IV. CONCLUSION

Vrana Ropana represents one of the most scientifically relevant contributions of Ayurveda to surgical science. The classical principles described by Acharya Sushruta continue to demonstrate remarkable similarity with modern concepts of wound healing. Ayurvedic management emphasizes individualized therapy through Shodhana, Ropana, herbal medicines, dietary regulation, and maintenance of systemic health.

Several Ayurvedic medicinal plants and formulations have demonstrated significant antimicrobial, anti-inflammatory, antioxidant, angiogenic, and collagen-enhancing properties in contemporary experimental and clinical studies. The integration of these evidence-based Ayurvedic therapies with modern wound care has the potential to improve healing outcomes, reduce complications, lower healthcare costs, and enhance patient quality of life. Future well-designed clinical trials and translational research will further establish the role of Ayurveda as an important component of evidence-based integrative wound management.

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