



"ADVANCES AND CHALLENGES IN THE MANAGEMENT OF CHRONIC NON-HEALING WOUNDS: A CRITICAL REVIEW"

Dr. Pradeep Kumar Pradhan¹, Prof. Dr. Sheetal Asutkar^{2*}, Dr. Yogesh Yadav³, Pratiksha Mandaokar⁴

¹PhD Scholar, Department of Shalya Tantra, Mahatma Gandhi Ayurveda College Hospital and Research Centre, Datta Meghe Institute of Higher Education and Research, Salod Wardha, Maharashtra, Orchid id: 0009-0007-7052-5178, Email: drpradhanpradeep25@gmail.com, contact no.- +91 9907930733

^{2*}M.S., PhD, Fellow Ayu Oncology, Prof and Head of Department, Department of Shalya Tantra, Mahatma Gandhi Ayurveda College Hospital and Research Centre, Datta Meghe Institute of Higher Education and Research, Salod Wardha, Maharashtra, Email: sheetalasutkar16@gmail.com, contact no.- +91 9766811974

³B.A.M.S., PG Scholar, Department of Shalya Tantra, Mahatma Gandhi Ayurveda College Hospital and Research Centre, Datta Meghe Institute of Higher Education and Research, Salod Wardha, Maharashtra, Email: dryogeshyadav00@gmail.com, contact no.- +91 7247286742

⁴Intern, Mahatma Gandhi Ayurveda College Hospital and Research Centre, Datta Meghe Institute of Higher Education and Research, Salod Wardha, Maharashtra

***Corresponding Author:** Prof. Dr. Sheetal Asutkar

*M.S., PhD, Fellow Ayu Oncology, Prof and Head of Department, Department of Shalya Tantra, Mahatma Gandhi Ayurveda College Hospital and Research Centre, Datta Meghe Institute of Higher Education and Research, Salod Wardha, Maharashtra, Email: sheetalasutkar16@gmail.com, contact no.- +91 9766811974

Abstract-

Maintaining the skin's barrier function requires the intricate and tightly controlled process of wound healing. Unfortunately, a number of contamination processes can interfere with the series of events that lead to wound healing, causing chronic wounds that never heal and putting a great deal of stress on both the patient and the healthcare system. Numerous variables need to be considered in order for a superficial wound to heal, and therapies and dressings for wounds have been created to address the challenges that can arise, such as pressure and infection. Wound tissue never fully recovers to its pre-injury strength, even during optimal healing, and certain aberrant healing states can result in chronic wounds that never fully heal. A chronic wound is one that does not heal in the expected stages and timeframe, or one that does not heal within three months. These wounds often remain in the inflammatory stage for too long and may never heal or take years. Chronic wound patients often experience persistent pain, which is the main problem for those with chronic ulcers. Some wounds may not heal easily due to their severity or the poor health of the individual. Any wound that does not heal within a few weeks should be examined by a healthcare professional, as it may be infected or indicative of an underlying disease. This article will discuss the structure of non-healing wounds and current strategies for treating chronic non-healing wounds.

Keywords: wound healing, non-healing wound, Dushta Vrana

Introduction:

Approximately 6.5 million people in the United States are affected by chronic and non-healing wounds, with an estimated economic impact of US\$25 billion [1]. Despite the availability of new and effective treatments, such as collagen dressings and high voltage pulsed current therapy, chronicity and delayed healing continue to cause suffering and, in some cases, death. It is estimated that 1-2 percent of people in the modern world may experience the effects of leg wounds that require skilled treatment throughout their lifetime. According to McGuckin et al., the dermal and epidermal layers of the skin interact with various molecules, growth factors, and extracellular proteins to repair a wound during the complex cycle of wound healing. However, the healing process may not always restore the damaged tissue as quickly as possible, leading to prolonged inflammation, proliferation, and remodeling of healing periods [2]. This can result in increased risk of infection, increased pain, decreased quality of life, and a burden on healthcare resources [3]. Non-healing wounds are often seen in patients with advanced disease [4]. In Ayurvedic terminology, these wounds are referred to as Vrana and are divided into Sadyo Vrana and Dushta Vrana [5]. According to Acharya Sushruta, Vrana Chikitsa is described in the Shashti upakramas, where the use of medicated oil is one of the main treatments [6]. In modern medicine, there are various treatment modalities available for chronic non-healing wounds, such as hyperbaric oxygen therapy, wound closure using a vacuum, immune molecular treatments, Z-Plasty, and human amniotic membrane allograft dehydrated. In Ayurveda, treatments such as Doovadi taila, Karanjyadi grita, leech therapy, Haridra and Neem oil combination, and Madhu are used [7].

Material and Methodology: -

The web-primarily based record sets, PubMed, PubMed Central, Ayusha Portal, and IndMed have been searched for references for watchwords "Non-healing Wound Treatment Modalities". The inquiry yielded references from the date of the beginning of the records units until July 2022. Trial papers, contextual analyses, and case collection in English, uncovering the reasons and remedy for non-healing wounds, have been remembered for the audit. concentrated on dialects aside from English, and whose digests had been inaccessible, had been prohibited from the survey. After making use of the incorporation and avoidance requirements and doing away with the copies, read up had been selected for the remaining survey.

Various treatment modalities for non-healing wounds are as follows:

Hyperbaric Oxygen Therapy (HBOT): In 1662, Henshaw helped construct the first hyperbaric chamber, commonly known as the "Domicilium," in London. Initially, room air was used to treat a variety of illnesses, but the low pressure was not sufficient to have a significant physiological effect. After Priestley's discovery of oxygen in the late 1700s, HBOT was used as an additional treatment for wound healing. Today, HBOT is used to treat carbon monoxide poisoning, crush injuries, compartment syndrome, severe ischemia, radiation damage, non-healing wounds, anaerobic infections, and osteomyelitis. It was originally developed to treat decompression sickness in deep-sea divers. The exact mechanism by which HBOT works is not fully understood, but it is believed to increase oxygen availability at the tissue level, which leads to vasoconstriction, reduced edema, and improved wound healing. Studies on people with diabetes and limb wounds have shown promising results. [8-12]

Vacuum Assisted Wound Closure: Since its first use in 1997, vacuum-assisted closure, also known as negative pressure, wound treatment, has gained a lot of attention. These devices can help with wound healing by creating a moist environment, increasing blood flow, eliminating fluid discharge, and applying pressure. Studies have shown that using this treatment leads to fewer complications. Dressing changes are necessary, but extensive debridement may not be required. Negative pressure wound treatment has the potential to successfully treat complex surgical wounds by gradually reducing the size of the wound.[13]

Immune Cell Therapies: Negative pressure wound treatment, also known as vacuum-assisted closure, has been used since 1997 and has gained a lot of attention. These devices can help with wound healing

by increasing blood flow, eliminating fluid discharge, creating a moist environment, and applying pressure. Studies have shown that using this treatment leads to fewer complications. Although frequent dressing changes are necessary, extensive debridement may not be required. Negative pressure wound therapy has the potential to effectively treat complex surgical wounds by gradually reducing the size of the wound and promoting healing.[14]

Z-plasty in non-wound healing: In plastic and reconstructive procedures, Z-plasty is often used to modify scars. This involves forming two triangle-shaped flaps that are lifted and moved along a main axis. Z-plasty does not require skin removal, unlike other scar modification methods. This technique allows for scar redirection, which reduces its visibility within relaxed skin tension lines or natural facial lines. It is effective in treating scar contractures caused by burns. Planimetric Z-plasty, double opposing Z-plasty, compound Z-plasty, asymmetric triangular Z-plasty, and fourfold Z-plasty are some of the variations of Z-plasty. Z-plasty has been shown to be superior to direct suturing in cases of non-healing wounds, resulting in less aberrant scar coloration and improved wound healing.[15]

Human amniotic membrane allograft dehydrated: Non-healing wounds have a major impact on individuals and society, as they affect 1-2% of people in their lifetime and are costly. Dried amniotic membrane allograft has shown potential in the treatment of chronic wounds that won't heal. EpiFix, a dried amniotic membrane, yielded positive results for both mild and severe wounds in four patients. With good patient tolerance, healing occurred after one to three membrane treatments. Healed wounds did not recur during long-term follow-up. Further research is needed to explore the wider use of dried amniotic membrane in various types of cutaneous lesions.[16]

Wound care and dressing: Due to the rise in chronic wounds, wound care has become increasingly important. An important aspect of wound care is debridement, the removal of non-viable tissue. This can be done through surgical or non-surgical means, with the goal of exposing healthy tissue that can proliferate and heal. The timing and frequency of debridement depend on the type of wound, but it is generally agreed to be an important part of wound care.[17]

Debridement: - The initial step in management for a stable patient with a wound that has been labeled as contaminated or filthy is debridement. Debridement can be selective or nonselective and can be carried out in a variety of ways. Utilizing endogenous or exogenous enzymes, selective debridement preserves healthy tissue while removing only debris or damaged tissues. Mechanical or hydrodynamic non-selective debridement techniques could unintentionally remove some healthy tissue along with the necrotic. Operative debridement aims to eliminate tissue that is hyperkeratotic, necrotic, functionally aberrant, and infected because all of these conditions impede wound healing. In this way, the residual tissue, despite having physiological impairments, can respond to external topical therapy more favorably. Debridement is a safe and efficient method for treating chronic wounds.

- 1) Elimination of the sepsis cause, which is known as the systemic inflammatory response syndrome in the presence of infection, is an indication for debridement.
- 2) eradicating the local infection to lower the bacterial load, lower the risk of antibiotic resistance, and acquire reliable cultures.
- 3) taking deep cultures from the tissue that was left over after debridement to determine whether a systemic antibiotic treatment is necessary for a persistent infection, and
- 4) stimulating the wound bed to hasten healing and get it ready for a skin graft, flap, topical growth factor application, or cell therapy. Wound bed preparation consists of four parts that treat the many pathophysiological problems that underlie chronic wounds:

1. Management of tissue

2. Control of infection and inflammation

3. Moisture equilibrium

4. Advancement of the epithelium (edge).

The T.I.M.E. framework includes complete solutions that can be utilized to treat different types of wounds in order to maximize the potential for wound healing. The concept of prepping the wound bed is well known, having been applied for over 20 years. Clinicians have found systematic assistance in managing and monitoring wounds with the acronym "TIME," which stands for tissue debridement, infection or inflammation, moisture balance, and edge effect. While the wound has traditionally been the main emphasis, the emerging concept of "wound bed preparation" promotes treating the patient holistically.[18]

Laser Therapy:- Low-power lasers and LEDs have been used in phototherapy recently to expedite wound healing in individuals with systemic or localized conditions that impair healing. Following laser therapy, the degree of inflammatory infiltration is decreased. The laser energy's red and infrared wavelengths promote faster wound epithelialization and increased fibroblast proliferation.⁶ Hawkins et al. studied the wound area of humans who received therapy with an 820 nm diode laser at 8 J/cm². After six days, they found that the surface area of the wounds treated with laser light had decreased by 153% compared to the wounds in the control group. Mejia et al.⁷ assert that utilizing a low-intensity laser can reduce wound healing times by 40%. [19]

PRP: - A significant development in the field of vascular therapeutics has been the use of cellular therapy to treat non-healing wounds. The components found in the blood and platelet concentrate, which contains a variety of cytokines and growth factors, are essential for the utilization of a patient's own body cells for the treatment of wounds and ulcers. There are no negative effects and these modular therapy solutions are both safe and efficient. Emerging cellular therapies have gained significant attention in the last 20 years, such as platelet-rich plasma (PRP) therapy, for their potential use in regenerative medicine as a therapeutic agent for a variety of chronic conditions. PRP therapy can also play an adjunctive role in a standardized, high-quality treatment plan. Platelets generated from whole blood are suspended in plasma to create autologous PRP being applied more frequently in clinical settings to treat persistent ulcers. PRP has a 2–6 fold–higher concentration of platelets than whole blood. Platelets are a physiological reservoir for a range of growth factors with healing functions, and they play an active part in tissue regeneration, which underlies the therapeutic characteristics of PRP. PRP is being employed as a new alternative method in a variety of medical specialties.[20]

Stem cell- Cell migration, proliferation, differentiation, extracellular matrix (ECM) deposition, and angiogenesis must be carefully coordinated in order for a wound to heal.[21] Under normal conditions, this process leads to re-epithelialization (i.e., the laying of a stratified epithelium over a temporary wound bed of collagen-rich granulation tissue).[22] Angiogenesis then takes place, supplying the newly created tissue with a self-sustaining artery and encouraging its full closure.[23,24] Multiple cellular and molecular processes are involved in these steps, which are well-regulated in the healing of acute wounds but dysregulated in those that do not heal.[25-26] It is believed that stem cells can be used therapeutically to treat wounds at various phases of the healing process, from angiogenesis to re-epithelialization. The goal of this literature review was to outline methods for employing MSCs to treat non-healing wounds, with an emphasis on delivery system variables that maximize closing a wound. The English-language literature reporting human or animal investigations published between 2000 and 2010 was sought after on MEDLINE and PubMed Central. The search used "nonhealing wounds" or "chronic wounds" or "wound healing" as well as "mesenchymal stem cells" or "stem cells" or "MSC" as keywords in the title or abstract. This review did not cover studies using non-MSCs. Seven studies in all were found, of which five reported murine models and two described human investigations.[27]

Negative pressure therapy -NPWT, introduced by Morykwas et al. in 1997, applies sub-atmospheric pressure to wounds, promoting healing by increasing blood flow and stimulating tissue formation. It can also improve skin graft adherence, reduce fluid buildup, and maintain a moist environment for healing.[28]

Electrical stimulation: Research has shown that electrical stimulation is effective in repairing skin tissue. However, the majority of electrical stimulations are administered using a percutaneous electrode, which can result in significant injury. It is anticipated that using non-contact electrical stimulation (NCES) will lessen the danger. In this study, a self-created useful gadget effectively exerted NCES. By using EF distribution analysis, electrode plates with a 10-cm spacing and suitable side lengths of 21 and 30 cm were chosen for applying NCES to cells and mice, respectively, and the actual EF strengths were recorded. To investigate the impact of NCES on wound healing, a single element that had no impact on the regular pattern of EF distribution was the change in loading voltage. The migration and proliferation of HaCaT cells and HDFs in vitro, as well as the M2-type polarization of macrophages, were later shown to be promoted by 53 mV mm⁻¹ NCES. Additionally, from the perspectives of minimizing scarring, boosting collagen production, and promoting angiogenesis in vivo, 54 and 84 mV mm⁻¹ NCESs sped up the wound healing rate of model mice. The significance of NCES in facilitating wound healing shown the potential to open up new avenues for the therapeutic treatment of damage to skin tissue.[29]

Skin Grafting: - Reuniting the skin could be possible. It was subsequently demonstrated that 53 mV mm⁻¹ NCES stimulated the migration and proliferation of HDFs and HaCaT cells in vitro as well as the M2-type polarization of macrophages. Additionally, 54 and 84 mV mm⁻¹ NCESs accelerated the rate at which model mice's wounds healed from the standpoints of reducing scarring, increasing collagen formation, and stimulating angiogenesis in vivo. The role that NCES plays in promoting wound healing has the potential to pave the way for novel approaches to the therapeutic management of skin tissue injury. the most well-known procedure for non-healing wounds, in which an injury is covered with skin or a skin substitute in order to replace and restore the damaged skin. Chronic pressure ulcers are a major problem and a major source of expense for Western countries, and many different kinds of treatment have been tried. Skin unifying is a therapeutic approach that reduces or eliminates the region of persistent leg ulcers, hence improving the patient's quality of life. Skin unifying is an ancient tactic that was rediscovered as the primary wound closure method during the First and Second Universal Wars. These days, skin grafting is crucial to the healing of recent injuries and the regeneration of tissue. The point of this survey was to follow and to break down the particular results this procedure accomplished, particularly somewhat recently, according to venous, blood vessel, diabetic, rheumatoid and horrible leg ulcers. Our principal discoveries show that autologous split-thickness skin joining actually stays the best quality level regarding security and viability for persistent leg ulcers; skin uniting strategies have better progress rates in ongoing venous leg ulcers contrasted with different kinds of constant leg ulcers; skin tissue designing, likewise upheld by hereditary control, is rapidly extending and, soon, may give far superior results in the space of therapies for durable constant wounds.[30]

Silver nanoparticles - Persistent non-healing wounds are a significant medical concern due to patient numbers and costs. Silver nanoparticles are of interest for their antibacterial properties. This study investigates a temperature-responsive film made from pullulan-g-pNIPAM, infused with two concentrations of silver nanoparticles (Ag-NPs). The film releases silver over 48 hours, similar to a commercial product. It shows excellent absorbency and antibacterial activity against *S. aureus* and *E. coli*, with good biocompatibility demonstrated on HeK293 cells. These nanocomposite films offer promise for managing non-healing wounds, releasing Ag-NPs at slightly elevated temperatures.[31]

Anti-biotic therapy - Persistent injuries, for example, diabetic foot ulcers frequently neglect to recuperate with regular treatments. Lately, it has been recognized that constant injuries are typically connected with raised degrees of network metalloproteinases (MMPs).Despite having no antibacterial properties, doxycycline, a mild antibiotic, has been shown to suppress MMPs in vivo and in vitro. When it comes to treating diabetic foot ulcers, doxycycline is a very encouraging medication to use because of its higher viability even at very low measurements, minimal side effects at lower doses, ability to restrain MMP and counteract/treat disease in the ulcers, gainfulness in treating cardiovascular issues, and low manufacturing cost.[32]

Ayurvedic Management of Dushta Vrana (Chronic Non-Healing Ulcer)

Doorvadi taila applied in Dushta Vrana: - Ayurveda mentions the oil *Doorvadi Taila* for the treatment of typical skin infections. Its usefulness in treating *Dushta Vrana* (ulcers) was evaluated in research together with *Jatyadi Taila*. Of the 40 patients that were enrolled, 38 finished the trial. *Jatyadi Taila* group received twenty, and *Doorvadi Taila* group received twenty. *Taila Pichu* therapy was administered to both groups for 37 days. Both groups showed a significant improvement in their *Dushta Vrana* symptoms. *Jatyadi Taila* showed abilities for early wound cleaning and healing, decreasing itching and discomfort, whereas *Doorvadi Taila* demonstrated possibilities for treating *Dushta Vrana* symptoms. [33].

Karanjyadi Grita: - Due to the presence of *Haridra*, *Nimba*, *Karanja*, and *Yashthimadhu*, *Karanjadhya Grita*, which has sixteen constituents including *Go-ghrita*, possesses "Vrana Ropana" characteristics. Properties known as "Vrana Shodhana" are ascribed to *Anantmool*, *Raktchandan*, *Patola*, and *Jati*. To increase its overall efficacy, *Haridra*, *Patola*, *Ushira*, and *Krishana Sariva* work together. Clinical investigations have proven that *go-ghrita*, a classic Ayurvedic remedy, has regenerative characteristics that help in wound healing and encourage the formation of healthy cells [34].

Leech Therapy: - For wound debridement, leech treatment using the T.I.M.E. a wound management paradigm is employed. It reduces inflammation and enhances microcirculation by acting as a coagulant, antibacterial, and sedative. The preparation of the bed and care of wounds both greatly benefit from leech therapy. The saliva of the leech consists of *Hirudine* which acts as anticoagulant. Because saliva contains chemicals like *betellinain* and *glins* that prevent leukocyte buildup in surrounding capillaries and suppress the production of inflammatory factors that lead to the creation of chronic wounds, saliva has anti-inflammatory properties. *Calin*, *Histamine*, *Eglins* and *Hyaluronidase*, act as vasodilator, anti-inflammatory and anesthetic agent respectively. These properties of leeches saliva help in reducing pain and size of ulcer and promote healing. Leech application reduces vascular congestion of the ulcer due to presence of *Carboxypeptidase A* inhibitors enzyme. Due to the presence of vasodilator elements, leech saliva has peripheral vasodilator effects. These effects promote wound healing by enhancing blood circulation and reversing "ischemia" surrounding the lesion. [35]

The Role of Neem Oil and Haridra Powder: - It is clear that diabetic ulcers frequently require ongoing therapy and have a tough time mending. Combining neem oil with *haridra* (turmeric), which may have a synergistic effect, has been utilized to heal these ulcers. While *Haridra* includes *curcumin*, which has anti-inflammatory and wound-healing characteristics, *Neem* oil contains *nimbin*, a compound with strong antibacterial capabilities. These two compounds work together to encourage the production of collagen, speed up re-epithelialization, and increase angiogenesis. *Neem* extract's antimicrobial properties and *curcumin*'s advantageous effects on cell mobility in the wound bed have both been proven in studies. This attests to their efficiency in enhancing wound healing results. [36]

The Role of Madhu in Dushta Vrana: - According to the 60 *Upakramas* of *Vrana*, *Madhu* has the qualities of *Vranaropak* (wound-healing), as stated in the *Sushruta Samhita*. *Madhura Vipaka*, *Kashaya Upparatha*, *Ruksha* (dry) *Guna*, *Sita* (cold) *Viriyā*, *Madhura Rasa*, and *Sukshma Marga Anusari* (perhaps saturating microchannels) *Prabhava* are all displayed by *Madhu*. It supports granulation, encourages molting, nourishes tissues, and speeds up wound healing. *Madhu* has proven to be effective at lowering *Vata dosha*, reducing pain, and enhancing recovery. It promotes phagocytosis, detoxifying, and proteolysis, which helps the healing of wounds. While *Kashaya Rasa* and *Ruksha Guna* promote healing and balance *Kapha dosha*, *Madura Rasa* and *Seeta Guna* balance *Pitta dosha* as well. Additionally, daily use of neem bark decoction on wounds prevents bacteria development. [37]

Discussion:

The most critical responsibility in the health-care system is chronic wound healing. Approximately 1-2% of the population has ongoing non-wound healing issues. Various studies and case studies have been undertaken in recent years, resulting in an expanded spectrum of therapy options for non-wound healing management. Superior strategies can be used to handle it appropriately. Although remedy can be applied

in current technological know-how therapies like hyperbaric oxygen therapy, there aren't many absolute contraindications. Due to air catch, the possibility to stretch pneumothorax, and increased dreariness with chemotherapy, responsive aircraft direction pollution, untreated pneumothorax, and concurrent chemotherapy are absolute contraindications. Ocular or nasal pain, claustrophobia, and brain oxygen impairment seen at high pressures are unpleasant reactions. It helps lessen unfavorable effects and provides treatment for air damage. It reduces the number of wounds required to heal the wound more quickly and saves a significant amount of money. 38Immune cell therapy, which promotes re-epithelialization and revascularization, is a promising treatment for nonhealing wounds. Due to inadequate vascularization, conventional treatments frequently fail, especially in patients with vascular conditions like peripheral artery disease or diabetes. The past 25 years have been devoted to the development of drugs that can improve the ability of the immune system to regenerate itself by the injection of substances directly into the wound site, increased mobilization, recruitment of cells to the wound, or modification of local activity. [39] A study conducted by Dr. Yang examined seventy-two patients treated with Z-plasty for unusual wound closure. Compared to standard therapy, Z-plasty patients experienced less discomfort and better outcomes in non-healing wounds. One popular orthopedic reconstructive procedure that is mostly utilized for scar reduction is Z-plasty. It involves transposing two triangular flaps to fill each other's defects, utilizing available tissue. This technique, described by Davis in 1946, has been widely recognized for its adaptability and effectiveness in plastic and reconstructive surgery.[40] Dehydrated human amniotic membrane, used since 1910, is effective in promoting granulation tissue formation in non-healing wounds. It also aids in forming new vasculature in leg ulcers and has bacteriostatic properties.[41]. Dehydrated human amniotic membrane is sometimes used as a low-cost burn therapy in impoverished nations. It has been shown to alleviate pain and accelerate recovery.[42] Experiments demonstrate the effectiveness of vacuum-assisted wound treatment in accelerating healing by increasing local blood flow, promoting granulation tissue, and inhibiting bacterial colonization. This method is particularly useful in treating fasciotomy wounds in leg compartment syndrome. Various wound dressings aim to prevent infection and promote healing. Moist occlusive dressings create an environment conducive to inflammation and re-epithelialization. Collagenase ointment is efficient for debriding necrotic tissue from pressure ulcers, leg ulcers, and partial thickness burn wounds. Limited data suggests papain-urea ointment may also be beneficial. Diabetic foot ulcers, common complications of diabetes, pose treatment challenges. Low-level laser therapy has emerged as a noninvasive, potentially effective treatment option for diabetic foot syndrome. [43,44,45,46] PRP therapy fosters tissue repair by supplying signaling cytokines and growth factors, regulating inflammation, angiogenesis, and tissue synthesis and remodeling.[47] In Ayurveda, non-healing of wounds is correlated with Dushta Vrana in Ayurveda. It is stated that shasti up krama may be used in the case of Dushta Vrana. The case takes a look at Doorvadi taila and proves that it's far more useful in the healing of wounds correctly. It calms Dushta Vrana's signs and symptoms.Karanjyadi ghrita has Vrana shodhan, Vrana ropan, and Vrana pachan belongings which are within the control of Dushta Vrana[48][49] The case takes a look at the LEECH remedy and proves that the leech remedy plays an essential position in Dushta Vrana's control with the aid of using its anticoagulant, anti-bacterial, and antiphlogistic belongings.[50] The combination of Neema Oil and Haridra powder is likewise the remedy modality in Ayurveda. In Dushta Vrana, the combination of each can be more effective than the individual use of each. Neem has antibacterial properties, whereas Haridra promotes faster wound closure and decreased inflammation.[51] In Madhu, in the chronic non healing wound, is a hyperosmotic medium that stops bacterial growth. Because of its high viscosity, honey forms a physical barrier, and the enzyme catalase gives it antioxidant qualities. After burns, honey helps to avoid contractures and hypertrophic scarring. Material. In our affected individuals, healing occurred with minimal wound association. Powdered drugs (Yashtimadhu, Shatavari, Gokshura, Guduchi) have mobilization-enhancing, immunomodulatory, and adaptogenic effects. These combinations apply the Rasayana effect. As the affected person grows older, give them Rasayana medicines to further increase the rasa, rakta, and mansa dhatus (tissues). This was supposed to result in healing of the injury and help affected individuals engage in and maintain good fitness. There were no accidents during treatment, and healing occurred as expected. The therapeutic technique is considered practical, safe, and easy to perform. The

best therapy over all therapies is leech therapy. It is cost-effective and can give better results with minimum complications. It is easily accessible and does not require heavy setups, so it can be considered as the best therapy. A significant advancement in the stimulation and acceleration of soft-tissue healing has been made in the treatment of non-healing ulcers with autologous platelet rich plasma.[52]

Conclusion:

The main issue faced with the aid of a medical professional is chronic wound non-healing that may be related to Dushta Vrana in Ayurveda. The prevalence of ongoing non-wound healing is between 1% and 2%. 1) Hyperbaric oxygen therapy is a recent technological advancement. For ongoing non-wound healing, several treatment options are available, including 2) Negative strain therapy, 3) Immune cell therapy, 4) Dehydrated amniotic membrane allograft, and 5) Z plasty. In Ayurveda, the treatments for leeches, neem oil, and the combination of Haridra powder and doorvadi taila are all listed as Shashti upakramas. 5) Madhu (honey) is an Ayurvedic treatment option for Dushta Vrana control.

References

1. McGuckin M, Waterman R, Brooks J, et al. Validation of venous leg ulcer guidelines in the United States and the United Kingdom. *Am J Surg* 2002; 183: 132-7.
2. Gurtner GC, Werner S, Barrandon Y, Longaker MT (2008) Wound repair and regeneration. *Nature* 453(7193):314-321.doi:10.1038/nature07039
3. Harding KG, Morris HL, Patel GK (2002) Science, medicine and the future: healing chronic wounds. *BMJ* 324(7330):160163
3. Sen CK, Gordillo GM, Roy S, Kirsner R, Lambert L, Hunt TK et al (2009) Human skin wounds: a major and snowballing threat to public health and the economy. *Wound Repair Regen Off Publ Wound Heal Soc Eur Tissue Repair Soc* 17(6):76
4. Bailey and Love's Short Practice of Surgery: Edited by Norman S. Williams, Christopher J.K.Bulstrode and P.Ronan O'Connell Published by London, Hodder Education, 25th. Edition-2008, Chapter 3, Pg. No.24-256.
5. Sushruta; Sushruta Samhita, Ayurvedatvasandipika, edited by kaviraj Dr Ambikadattashastri: Published by Varanasi, Choukambha Surbharati Prakashan -2007. Chikitsa Sthana 1/57-58, Pg. No.10.
6. Pankaj B. Patil Dissertation of Rajiv Gandhi University of Health Science Bangalore, Karnataka 2011 Page No.81(VB GroupApplication)
7. S. Hunter, D. K. Langemo, J. Anderson, D. Hanson, and P. Thompson, "Hyperbaric oxygen therapy for chronic wounds,"*Advances in Skin &Wound Care*, vol. 23, no. 3, pp. 116 119,2010.
8. J. V. Boykin, "Hyperbaric oxygen therapy: a physiological approach to selected problem wound healing,"*Wounds*, vol.8, no. 6, pp. 183-198, 1996.
9. W. A. Zamboni, H. P. Wong, L. L. Stephenson, and M. A. Pfeifer, "Evaluation of hyperbaric oxygen for diabetic wounds: a prospective study,"*Undersea and Hyperbaric Medicine*, vol.24, no. 3, pp. 175-179, 1997[63] P. Kranke, M. Bennett, I. Roeckl-Wiedmann, and S. Debus.
10. Venturi ML, Attinger CE, Mesbahi AN, Hess CL, Graw KS. Mechanisms and clinical applications of the vacuum-assisted closure (VAC) device: a review. *Am J Clin Dermatol.* 2005;6(3):185-94.
11. Groppa, E.; Colliva, A.; Vuerich, R.; Kocijan, T.; Zacchigna, S.Immune Cell Therapies to Improve Regeneration and Revascularization of Non-Healing Wounds. *Int. J. Mol. Sci.* 2020, 21, 5235. <https://doi.org/10.3390/ijms21155235>. Clinical study on orthopaedic treatment of chronic osteomyelitis with soft tissue defect in adults, *International Wound Journal*, 10.1111/iwj.13729.
12. homas J Koob, Robert Rennert, Nicole Zabek, Michelle Masee, Jeremy J Lim, Johnna S Temenoff, William W Li, Geoffrey Gurtner, Biological properties of dehydrated human amnion/chorion composite graft: implications for chronic wound healing, *International Wound Journal*, 10.1111/iwj.12140, 10, 5, (493-500), (2013).
13. Mulder G, Jones R, Cederholm-Williams S, Cherry G, Ryan T. Fibrin cuff lysis in chronic venous ulcers treated with a hydrocolloid dressing. *Int J Dermatol.* 1993;32(4):304–306. doi: 10.1111/j.1365-4362.1993.tb04275.x. [PubMed] [CrossRef] [Google Scholar]

14. Brem H, Stojadinovic O, Diegelmann R, Entero H, Lee B, Pastar I, et al. Molecular markers in patients with chronic wounds to guide surgical debridement. *Mol Med*. 2007;13(1–2):30–9. [PMC free article] [PubMed] [Google Scholar]
15. 19.Pereira FLC, Ferreira MVL, da Silva Mendes P, Rossi FM, Alves MP, Alves BLP. Use of a high-power laser for wound healing: a case report. *J Lasers Med Sci*. 2020;11(1):112-114. doi:10.15171/jlms.2020.19.
16. Suthar, M., Gupta, S., Bukhari, S. et al. Treatment of chronic non-healing ulcers using autologous platelet rich plasma: a case series. *J Biomed Sci* 24, 16 (2017).
17. Singer AJ, Clark RA. Cutaneous wound healing. *N Engl J Med* 1999;341:738-46.
18. Cited Here | View Full Text | PubMed | CrossRef 22.
19. Fathke C, Wilson L, Hutter J, et al. Contribution of bone marrow-derived cells to skin: collagen deposition and wound repair. *Stem Cells* 2004;22:812-22. Cited Here | PubMed | CrossRef
20. Lau K, Paus R, Tiede S, Day P, Bayat A. Exploring the role of stem cells in cutaneous wound healing. *Exp Dermatol* 2009;18:921-33. Cited Here | View Full Text | PubMed | CrossRef .
21. Li WW, Talcott KE, Zhai AW, Kruger EA, Li VW. The role of therapeutic angiogenesis in tissue repair and regeneration. *Adv Skin Wound Care* 2005;18:491-500. Cited Here | View Full Text | PubMed | CrossRef
22. Wu Y, Chen L, Scott PG, Tredget EE. Mesenchymal stem cells enhance wound healing through differentiation and angiogenesis. *Stem Cells* 2007;25:2648-59.Cited Here | PubMed | CrossRef
23. Sasaki M, Abe R, Fujita Y, Ando S, Inokuma D, Shimizu H. Mesenchymal stem cells are recruited into wounded skin and contribute to wound repair by transdifferentiation into multiple skin cell type. *J Immunol* 2008;180:2581-7. Cited Here | PubMed | CrossRef
24. Li H, Fu X, Ouyang Y, Cai C, Wang J, Sun T. Adult bone-marrow-derived mesenchymal stem cells contribute to wound healing of skin appendages. *Cell Tissue Res* 2006;326:725-36.
25. .Zheng-Ying Jiang, Xiao-Ting Yu, Xin-Cheng Liao, Ming-Zhuo Liu, Zhong-Hua Fu, Ding-Hong Min, Guang-Hua Guo Negative-pressure wound therapy in skin grafts: A systematic review and meta-analysis of randomized controlled trials
26. Junwei Xu a, Yunxue Jia a, Weizhen Huang a, Qiusheng Shi a, Xuemei Sun a, Lisha Zheng a, Ming Wang b, Ping Li a Non-contact electrical stimulation as an effective means to promote wound healing.
27. Serra R, Rizzuto A, Rossi A, Perri P, Barbetta A, Abdalla K, Caroleo S, Longo C, Amantea B, Sammarco G, de Franciscis S. Skin grafting for the treatment of chronic leg ulcers - a systematic review in evidence-based medicine. *Int Wound J*. 2017 Feb;14(1):149-157. doi: 10.1111/iwj.12575. Epub 2016 Mar 4. PMID: 26940940; PMCID: PMC7949524.
28. Paneysar JS, Barton S, Ambre P, Coutinho E. Novel Temperature Responsive Films Impregnated with Silver Nano Particles (Ag-NPs) as Potential Dressings for Wounds. *J Pharm Sci*. 2022 Mar;111(3):810-817. doi: 10.1016/j.xphs.2021.11.009. Epub 2021 Nov 20. PMID: 34808215.
29. Xu DH, Zhu Z, Fang Y. The Effect of a Common Antibiotics Doxycycline on Non-Healing Chronic Wound. *Curr Pharm Biotechnol*. 2017;18(5):360-364. doi: 10.2174/1389201018666170519095339. PMID: 28524000.
30. Jetesh Ray et al. Clinical study on doorvadi taila in management of dushta Vrana. *Int. J. Res. Ayurveda Pharm*. 2018;9(6):22-27://dx.doi.org/10.7897/2277-4343.096166d
31. Jetesh Ray et al. Clinical study on doorvadi taila in management of dushta Vrana. *Int. J. Res. Ayurveda Pharm*. 2018;9(6):22-27 http://dx.doi.org/10.7897/2277-4343.096166
32. Asutkar, S. G., &Bhatbhage, B. (2018). A Conceptual Study of Wound Bed Preparation by Leech Therapy (Jallaukavacharana) In Patients of DushtaVrana w. s. r. Chronic Non-Healing Wound. *Airline: International Journal of Research in Indian Medicine*, 2(06). https://doi.org/10.52482/ayurline.v2i06.158
33. Singh A, Singh AK, Narayan G, Singh TB, Shukla VK. Effect of Neem oil and Haridra on non-healing wounds. *AYU [serial online]* 2014 [cited 2022 Jul 3];35:398-403. Available from: https://www.ayujournal.org/text.asp?2014/35/4/398/158998

34. Tukaram S. Dudhamal, S. K. Gupta, and C. Bhuyan Role of honey (Madhu) in the management of wounds (Dushta Vrana) *Int J Ayurveda Res.* 2010 Oct-Dec; 1(4): 271–273. DOI: 10.4103/0974-7788.76793 PMID: 21455457
35. Teguh DN, Bol Raap R, Koole A, Knippenberg B, Smit C, Oomen J, van Hulst RA. Hyperbaric oxygen therapy for nonhealing wounds: Treatment results of a single center. *Wound Repair Regen.* 2021 Mar;29(2):254–260. doi: 10.1111/wrr.12884. Epub 2020 Dec 30. PMID: 33377598; PMID: PMC7986203
36. Groppa E, Colliva A, Vuerich R, Kocijan T, Zacchigna S. Immune Cell Therapies to Improve Regeneration and Revascularization of Non-Healing Wounds. *Int J Mol Sci.* 2020 Jul 23;21(15):5235. doi: 10.3390/ijms21155235. PMID: 32718071; PMID: PMC7432547.
37. Zhang X, Wang G, Sun Y, Ding P, Yang X, Zhao Z. The Z-plasty contributes to the coalescence of a chronic non-healing wound. *Int Wound J.* 2021;18:796–804. 10.1111/iwj.13583 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
38. Faulk WP, Matthews R, Stevens PJ, Bennett JP, Burgos H, Hsi BL. Human amnion as an adjunct in wound healing. *Lancet* 1980;1:1156–8. [PubMed] [Google Scholar]
39. Ramakrishnan KM, Jayaraman V. Management of partial-thickness burn wounds by amniotic membrane: a cost-effective treatment in developing countries. *Burns* 1997;23(Suppl 1):S33–6. [PubMed] [Google Scholar]
40. Ansari TA, Barik S, Meena P, Arora S. Comparison of Topical Oxygen with Vacuum Assisted Closure in Wound Healing in a Low Resource Setting. *Ethiop J Health Sci.* 2022 Sep;32(5):955–962. doi: 10.4314/ejhs.v32i5.11. PMID: 36262707; PMID: PMC9554766.
41. Jones V, Grey JE, Harding KG. Wound dressings. *BMJ.* 2006;332(7544):777–780. doi: 10.1136/bmj.332.7544.777. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
42. Ramundo J, Gray M. Enzymatic wound debridement. *J Wound Ostomy Continence Nurs.* 2008 May-Jun;35(3):273–80. doi: 10.1097/01.WON.0000319125.21854.78. PMID: 18496083.
43. Beckmann KH, Meyer-Hamme G, Schröder S. Low level laser therapy for the treatment of diabetic foot ulcers: a critical survey. *Evid Based Complement Alternat Med.* 2014;2014:626127. doi: 10.1155/2014/626127. Epub 2014 Mar 16. PMID: 24744814; PMID: PMC3976827.
44. Sebastian KMS, Lobato I, Hernandez I, et al. Efficacy and safety of autologous platelet rich plasma for the treatment of vascular ulcers in primary care: phase III study. *BMC Fam Pract.* 2014;15:211. doi: 10.1186/s12875-014-0211-8. [PMC free article] [PubMed] [CrossRef] [Google Scholar] Jetesh Ray et al. Clinical study on doorvadi taila in management of dushta Vrana. *Int. J. Res. Ayurveda Pharm.* 2018;9(6):22-27://dx.doi.org/10.7897/2277-4343.096166d
45. Jetesh Ray et al. Clinical study on doorvadi taila in management of dushta Vrana. *Int. J. Res. Ayurveda Pharm.* 2018;9(6):22-27 http://dx.doi.org/10.7897/2277-4343.096166
46. Asutkar, S. G., & Bhatbhage, B. (2018). A Conceptual Study of Wound Bed Preparation by Leech Therapy (Jallaukavacharana) In Patients of Dushta Vrana w. s. r. Chronic Non-Healing Wound. *Ayrline: International Journal of Research in Indian Medicine*, 2(06). <https://doi.org/10.52482/ayurline.v2i06.158>
47. Singh A, Singh AK, Narayan G, Singh TB, Shukla VK. Effect of Neem oil and Haridra on non-healing wounds. *AYU [serial online]* 2014 [cited 2022 Jul 3];35:398-403. Available from: <https://www.ayujournal.org/text.asp?2014/35/4/398/158998>
48. Tukaram S. Dudhamal, S. K. Gupta, and C. Bhuyan Role of honey (Madhu) in the management of wounds (Dushta Vrana) *Int J Ayurveda Res.* 2010 Oct-Dec; 1(4): 271–273. DOI: 10.4103/0974-7788.76793 PMID: 21455457