



ISSN 2456-3110

Vol 2 - Issue 1

Jan-Feb 2017

Journal of  
**Ayurveda and Integrated  
Medical Sciences**

*www.jaims.in*

JAIMS



**Charaka**  
Publications

Indexed

# Dietary Regimen for Wound Healing - An Ayurveda Perspective

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## ABSTRACT

Wound care is constantly devolving with the advances in medicine and expanding with advancement in technology. It is equally essential to look back into age old principles that were practised and follow them logically. *Acharya Sushruta* has given due importance to explain about wound care. *Shalya Tantra* is one of the important branch of *Ayurveda*, in which surgical and para-surgical techniques has been described for the management of various diseases. *Vrana* (wound) is the most important and widely described chapter of *Shalya Tantra*. Integrated wound care with managed dietary regimen can give better prognosis and Increases life expectancy. Balanced diet enables quick reaction to the wound or trauma itself, as well as enhanced the healing capabilities throughout the curative process. Nutrient deficiencies can reflect as chronic wound or delayed healing status. Nutrition not only facilitates healing, but also improves or stabilize the patient's Quality of life.

**Key words:** *Vrana*, Malnutrition, wound healing.

## INTRODUCTION

In today's fast paced life, many norms regarding diet and regimen have been compromised which is showing the overall decaling status of health in the society. Ayurveda has been emphasizing more on the importance of diet and lifestyle in the maintenance of health. So by following the *Ahara* and *Vihara* one can get good health and maintaining it throughout the life. Diet and Health are more connected in the area of wound care. Wound care is a concept of rehabilitation provided to a patient either post-operatively or as a part of post-trauma

management.

Most wounds on healthy people heal quickly when kept clean and free of infection, while other types of wounds are more serious and often require medical intervention. These can include decubitus ulcers, also known as pressure sores or bed sores, which develop where bones are close to the skin - such as ankles, back, elbows, heels and hips - in people who are bedridden, use a wheelchair or are unable to change their position. People with diabetes also have a higher risk of developing foot ulcers that can take weeks or months to heal.

Food choices and nutritional status influence wound healing since serious wounds increase the energy, vitamin, mineral and protein requirement is necessary to promote healing. Also, nutrients are lost in the fluid that weeps from wounds. Malnutrition is a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein and other nutrients causes measurable adverse effects both on tissue/body structure and function (Abbasi and Rudman, 1993).<sup>[1]</sup> Malnutrition can increase the risk of developing certain wounds, such as pressure ulcers, and if a wound does develop, malnutrition can impair

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Submission Date : 14/02/2017

Accepted Date: 28/02/2017

Access this article online

Quick Response Code



Website: [www.jaims.in](http://www.jaims.in)

DOI: 10.21760/jaims.v2i1.7505

immune function and delay healing. However, malnutrition is a reversible risk factor for wounds. Early identification and management of malnutrition promotes wound healing (Thomas and Furhrman, 2005).

### Wound healing Stages

The wound-healing process is not linear and can progress forward and backward through the phases depending on various intrinsic and extrinsic factors. In any type of open wound, three stages or phases are mandatory in healing process. They are as follows;

1. Inflammatory phase
2. Collagen phase or Proliferative phase
3. Maturation phase or regeneration phase/remodelling phase

The healing process begins immediately following an injury. The healing process replaces the damaged tissue and rebuilding the healthy connective tissue in sequential manner. The redness, swelling, heat and pain are clinical signs of inflammation occur during healing process.

### Influence of under nutrition on Wound Healing<sup>[2]</sup>

Wound failure/delayed healing is reflected by wound infections and/or significantly contributes to the financial burden imposed on health care systems worldwide. <sup>[3]</sup>

Under nutrition impedes healing of both acute and chronic wounds. In malnourished Patients the chances of wound infection and delayed wound healing is more in compare to normal individual. Many nutrients are involved in connective tissue repair and wound healing, such as amino acids, selective vitamins and minerals. Plenteous evidences of nutritional satiety reflect that planned elective surgery in malnourished patients significantly reduces the complications. In a study of nutritional status as a predictor of wound healing after amputation, normal albumin and total lymphocyte levels correlated with increased rate of healing. <sup>[4]</sup>

Wound healing is delayed in subjects who had periods of starvation before injury or a surgical procedure due

to the lack of endogenous substrates. Further under-nutrition impedes wound healing by delayed neovascularization and decreased collagen synthesis, prolonged phase of inflammation, decreased phagocytosis by leukocytes, and dysfunction of B and T cells, decreased mechanical strength of the skin.

**Table 1: Factors that negatively influence wound healing.**

Local factors	Systemic factors
Scalds and burns.	Trauma
Local pressure	Diabetes mellitus.
Compromised vascular perfusion - arterial, venous, or mixed	Malnutrition and nutritional deficiencies
Neurologic defects	Advanced age
	Corticosteroids or immunosuppressive drugs
	Psychosocial stress.

### Immunomodulation for healing chronic wounds

In addition to appropriate antibiotic therapy, an intact, functioning immune system is vital to preventing and clearing wound infection. The immune system is tied to overall host nutrition and specific nutritional entities, such as arginine and its related metabolic pathways. In critically ill patients, it is crucial that nutritional status be optimized to provide increased substrate availability to meet the demands of tissue repair and immune function and to prevent wounds from succumbing to infection and delayed healing. <sup>[5]</sup>

### Nutritional supplements<sup>[6]</sup>

Wound healing is anabolic process that requires both energy and nutritive substrates. It is reported that serum albumin level of 3.5gm/dl or more is necessary for proper wound healing. <sup>[7]</sup> The clinical significance of nutrition and wound healing involves individual patients with unique needs. The goal of the physician is to determine whether, when, and how nutritional supplementation is needed. <sup>[8]</sup> Optimum nutritional state can be achieved by providing the individual with

adequate energy and nutrients, and preventing protein energy malnutrition. Foods high in protein and carbohydrates include milk, cheese, meat, eggs and bread, cereals. Adding fats to meals such as butter and cream, along with choosing full fat varieties will increase the energy content further. It is important that these are presented in a suitable way, for example, patients with swallowing difficulties may require a modified consistency.

Fresh Vegetables and fruits are rich sources of micronutrients and macronutrients. The micronutrients present are minerals (like iron and calcium) and vitamins (like vitamin C, folic acid, B complex vitamins and carotenoids) whereas, the macronutrients present are complex carbohydrates/fibre. They contain abundant amounts of iron, calcium, vitamin C, folic acid, carotenoids (precursors of vitamin A) and phytochemicals. Some vegetables and fruits provide very low calories.<sup>[9]</sup>

**Carbohydrates** - Carbohydrate is primary source of energy. Its availability is essential to prevent other nutrients (protein) from being converted into energy. Glucose is source which used to generate cellular energy in the form of ATP. Wound requires energy for collagen synthesis. Carbohydrate sources include whole grain cereals, breads, rice.

Hyperglycaemia decrease leucocyte chemo taxis which results in decreased early inflammatory response and impaired wound healing in Diabetic patients. It interferes with the cellular transport of ascorbic acid into fibroblasts and leucocytes.

**Protein** - Protein is essential for the maintenance and repair of body tissue and for collagen synthesis on wound site. A state malnutrition may provide an inadequate amount of protein and this can decreased the rate of collagen synthesis wound tensile strength, increased chance of infection<sup>[10]</sup> or decreased skin and fascial wound-breaking strength.<sup>[11]</sup>

In the clinical observation some patients exhibits protein energy malnutrition (PEM). PEM causes the body to break down protein for energy, reducing the supply of amino acids needed to maintain body proteins and healing and causing loss of lean body

mass. Therefore, PEM may be directly linked to wounds that are not healing.<sup>[12]</sup> This cascade demonstrates the severely negative impact poor nutrition can have on chronic wound healing. Protein includes cheese, legumes, eggs, meat, fish, milk, yogurt, nuts and seeds.

**Amino acids** - Arginine and glutamine have been the most extensively animal studied amino acids in the wound-healing process.

**Arginine** - Arginine is a dibasic amino acid synthesized endogenously. In situations of stress or injury, arginine decrease rapidly. Arginine maintains positive nitrogen balance, growth factor release and T-lymphocyte stimulation. As it is a unique substrate for the generation of nitric oxide (a highly reactive radical), which may play a critical role in wound healing. *Arginine* supplementation may play an especially important role in the wound healing of diabetic patients.

**Glutamine** - Glutamine is the most abundant amino acid in the body. Glutamine is an important precursor for the synthesis of fibroblasts and macrophages.<sup>[13]</sup> Glutamine stimulates inflammatory immune response and essential for lymphocyte proliferation which occurs in early wound healing.

**Fats** - Linoleic and arachidonic acid are among the unsaturated fatty acids that are allow for prostaglandin synthesis. Prostaglandins play critical roles in cellular metabolism and inflammation. Phospholipids are key constituents of cellular basement membranes. Omega-3s, found in such as: Halibut, Herring, Mackerel, Oysters, Salmon, Sardines, Trout, Tuna (fresh). Studies of burn healing in humans demonstrates diet rich in omega-3 fatty acids improves immune function, survival and reduces infectious complications in specific subset of injured patients.<sup>[14]</sup> Fats contribute to texture, flavour and taste and increase the palatability of the diet. Fats are essential for meeting some of the nutritional needs like essential fatty acids (linoleic n-6 and alpha-linolenic n-3) and serve as rich sources of energy. Therefore, fats should be consumed, in moderation.

**Vitamin** - Vitamin A and C are closely associated with wound healing. In vitro studies shows increased collagen synthesis of fibroblast cell cultures in the presence of Vitamin A.<sup>[15]</sup>

Vitamin C has multiple functions as a co-enzyme and co-factor in many of the body's biochemical pathways. As it relates to connective tissue, vitamin C is required for collagen fibre synthesis, a process vital for tissue repair and healing. Specifically, it is involved in the hydroxylation of proline to form hydroxyproline. Research by Patel<sup>[16]</sup> confirms that ascorbic acid acts as a specific inducer of the collagen pathway. A deficiency in vitamin C is associated with poor collagen formation and delayed wound healing.

Vitamin B complex have an indirect role in wound healing through its influence on host resistance.

Vitamin E possesses anti-inflammatory properties, maintains and stabilizes cellular membrane integrity, primarily by protection against destruction by oxidation.<sup>[17]</sup> In chronic wounds of the lower extremity, vitamin E may decrease excess scar formation.<sup>[18]</sup>

#### Micronutrients

Micronutrients (Magnesium, Zinc and Iron) are essential components of cellular function. It is difficult to associate deficits in specific minerals and trace elements to impairments in wound healing, because micronutrient deficiencies almost always are accompanied by other coexisting metabolic or nutritional disturbances.<sup>[19]</sup>

**Magnesium** - is essential for wound repair and functions as a cofactor for many enzymes involved in protein and collagen synthesis.<sup>[20]</sup>

**Zinc** - is a cofactor for both RNA and DNA polymerase and, therefore, is involved in DNA synthesis, protein synthesis, and cellular proliferation. Zinc deficiency impairs fibroblast proliferation and collagen synthesis, leading to decreased wound strength and delayed epithelialization. This processes leads to delay wound healing.<sup>[21]</sup>

**Iron** - Iron is a component of the oxygen transport system to the site of wound. Iron deficiency can result from blood loss, malnutrition and underlying haematopoietic disorders. Severe iron deficiency anaemia can result in impaired collagen production.<sup>[22]</sup>

**Phytonutrients** - Vegetables provide phytochemicals and considerable health significance to the human body. Among these, dietary fibre, antioxidants and other bio-active constituents require special mention. These special factors are required for delaying ageing and preventing the processes which lead to diseases such as cataract, cardio-vascular diseases, diabetes and cancer.

**Table 2: Source of Micro and Macronutrients.**

Source	Nutrients
Pulses, Nuts and oil seeds	B-complex vitamins, invisible fat, fibre
Green Leafy Vegetables	Antioxidants, fibre and othercarotenoids
Other Vegetables And Fruits	Fibre, sugar and antioxidants
Whole Grain Cereals, Millets	Protein, fibre, minerals, calcium, iron and B - complex vitamins
Vegetable Oils, Ghee, Butter	Fat soluble vitamins, essential fattyAcids

#### **Pathya-Apathya as mentioned in Ayurveda classical texts.**

In classical text of Ayurveda Shaak, Shuk- Shimbi Dhanya, Jangal Mansa Rasa, Ghrita, Yusha, Vipeli are mentioned as *Pathya Dravya* for proper healing of wound while Nava Dhanya, Tila, Masha, Ksheera, Ikshu-Vikriti as *Apathya aahar*. *Nitanta Chankraman, Shoka, Uccha-Paribhashan* as *Apathya Vihara*.

*Tanduleeyaka, Vastuka, Jeevanti, Sunnishnnaka* are green leafy vegetable that have *Mutravirechniya*,

*Deepana, Pachana* properties. These are rich source of these High fibres, carotenoids and micronutrient as antioxidant, immunomodulating properties which help to nutritional support for healing promotions. *Vartaka, Patol, Karvellaka* and *Karkotak* are as vegetable fruits having *Agnideepana, Pachana, Kaphapittahara* properties. These are also rich source of fibre, amino acids. *Yava, Godhuma, Sashtika Shali* are having *Balya, Kapha-Vatahara* and *Ruchya* properties. *Aamlaka* and *Dadima* fruits are also *Ruchya, Deeepana* with rich souce of Vitamin C, which is a co-factor in collagen synthesis for proper wound healing. *Yusha* of *Masura, Tuvvari* and *Mudag* have *Laghu, Ruksha, Madhura, Grahi* and *Kapha-Pittahara* property. *Srita Jala* is also *Laghu* and *Deepana*. *Jangala Mansa Rasa* is rich in protein which has a significant role in collagen synthesis and wound maturation. *Ghrita* provides Vitamin A and D required for collagen synthesis.

*Nava Dhanya, Tila, Masha, Ksheera, Ikshu Vikriti* are *Guru, Snigdha* and *Kapha-Pitta Vardhaka, Kleda Vardhaka* that's why contraindicated in wounded person.

**Table 3: Pathya- Apathya from classical texts of Ayurveda.**

Classics	Pathya	Apathya
Charaka (Chi.25/97-98)	<i>Na Ati Sheet, Na Ati Guru, Na Ati Snigdha, Avidahi, Aswapnam Diva.</i>	<i>Lavan, Amla, Katu, Ushna, Vidhahi, Guru, Methunam.</i>
Sushruta (Sutra.19/33-36)	<i>Tanduliyaka, Jivanti, Sunishannak, Vastuk, Bal-Mulak, Vartak, Patol, Karvellak, Dadim, Amlak, Saindhav, Mudaga Rasa, Saktu, Vilepi, Kulmasha, Shrit-</i>	<i>Divya-Nidra, Aayas, Jagran, Methunam.</i>

	<i>Jala.</i>	
Vagbhatta (Sutra.29/34-40)	<i>Yava, Godhuma, Sashtatika, Masura, Mudaga, Tuvvari, Jivanti, Sunissnika, Bal-Mulaka, Vartaka, Tanduliyak, Vastuka, Karvellak, Karkota, Patola, Katukaphala, Saindhava, Dadima, Dhatri, Ghrita, Jala, Jangala Mansa Rasa.</i>	<i>Nava Dhanya, Tila, Masha, Mansa, Ksheera, Ikshu-Vikrati, Amla, Katu, Visthambi, Vidahi, Guru, Sheetal, Madhya.</i>
Yogratnakar (Sarva Vrana Roga Pathya-Apathya)	<i>Yava, Sashtika, Godhuma, Shali, Yusha (Masura, Tuvvari, Mudga), Madhu-Sharkra, Vilepi, Laj-Manda, Jangala Mriga-Pakshi, Ghrita, Taila, Patola, Vaitagra, Bal-Mulaka, Vartaka, Karvellaka, Karkota, Tanduliyaka.</i>	<i>Ruksha, Amla, Sheeta, Lavana, Vyavaya, Aayasa, Ucche-Paribhasanam, Priyasama-Alokanam, Nidra, Prajagaram, Nitanta Chankraman, Shoka, Viruddhashana, Ambu Pana, Tambula, Patra-Shaka, Ajangal Mansa.</i>

Proper dietary pattern and rich nutrient diet helps to improve healing is proved scientifically. As compares with classics *Charaka, Sushruta, Vagbhata* and *Yogratnakara*, it can be summarised that proper lifestyle management can improve healing without any complication

### Nutrient considerations of *Pathya Dravyas* mentioned in Ayurved texts.

**Jeevanti (*Leptadenia reticulata* Linn.)** - Acharya Charaka mentioned it as the best whole some vegetable to be consumed for maintaining the good health. Kirtikar and Basu<sup>[23]</sup> mentioned it as a stimulant and tonic. The leaves paste and roots are taken orally with water to cure gangrene.<sup>[24]</sup>

**Tanduleeyaka (*Amaranthus spinosus* L.)** - Amaranthus is highly nutritious. High dietary fibre content (3 times that of wheat) in the greens improve digestive health. Leaves<sup>[25]</sup> contains Fibres, Protein, Fat, Carbohydrate, Vit. A, Vitamin B<sub>6</sub>, and Vitamin C. Amaranth leaves are terrific source of manganese, iron, copper, calcium, magnesium, potassium and phosphorus necessary for maintaining proper mineral balance in the body.

**Karvellaka (*Momordica charantia* L.)** - Bitter gourd being rich in all the essential vitamins and minerals.<sup>[26],[27]</sup> especially Vitamin A, B<sub>1</sub>, B<sub>2</sub>, C, Iron, Folic acid, Zinc, Manganese, Copper, Amino acids (*aspartic acid, serine, glutamic acid, threonine, alanine, g-amino butyric acid and pipercolic acid, luteolin*) and Fatty acids (*Lauric, myristic, palmitic, palmitoleic, stearic, oleic, linoleic, linolenic acid*). Studies have shown that it contains a hypoglycemic or insulin-like principle, which has been found highly beneficial in lowering the blood and urine sugar levels.<sup>[28]</sup> It should, therefore, be included liberally in the diet of the patients suffering from diabetes. An extract of the entire plant was shown to have antiprotozoal activity against *Entamoeba histolytica*.<sup>[29]</sup>

**Patola (*Trichosanthes dioica* Roxb.)** - It is rich in protein and vitamin A, vitamin C, carotene, tannins and saponins. It possess antioxidant activity responsible for lowering blood sugar and serum triglycerides.<sup>[30]</sup>

**Vastuka (*Chenopodium album* L.)** - It was also found to contain Vitamins C and  $\beta$ -carotene, potassium, sodium, calcium, magnesium, iron and zinc in high amounts followed by many other beneficial nutrients. A high content of potassium can provide

relief from stroke, blood pressure, heart and kidney disorders, also enhance muscle strength, water balance, electrolytic functions and nervous system. It also contains iron which is used against anaemia, tuberculosis and disorders of growth. Zinc supplementation in diabetes mellitus proved to have antioxidant effect.<sup>[31]</sup>

**Sunisannak (*Marsilea quadrifolia* Linn.)** - Juice extracted from the leaves is diuretic and febrifuge and also used to treat snake bite and applied to abscesses etc. The plant have anti-inflammatory, diuretic, depurative, antioxidant, appetite stimulation, tonic, immune stimulation and aphrodisiac properties due to the presence of active principles such as alkaloids, flavonoids, pigments, phenolics, terpenoids, steroids and essential oils.<sup>[32],[33]</sup>

**Vrintak (*Solanum melongena* L.)** - It is a rich sources of various phenolics, flavonoids and vitamins such as vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin B<sub>6</sub>, vitamin C and fairly balanced amount of minerals. It suppress the development of blood vessels required for tumor growth metastasis. It contains good amounts of many essential B-complex groups of vitamins such as pantothenic acid (vitamin B<sub>5</sub>), pyridoxine (vitamin B<sub>6</sub>) and thiamin (vitamin B<sub>1</sub>), niacin (B<sub>3</sub>).<sup>[34]</sup>

**Karkota (*Momordica dioica*)** - Fruits of *Momordica dioica* are good source of fiber, protein, carbohydrates, vitamins (A, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, K), calcium, magnesium, potassium, copper, zinc and oleic acid.<sup>[35]</sup>

### CONCLUSION

Eat a wide variety of *Pathyaahara* every day to maintain health and to boost up the immune functions. Nutritional needs are complex and vary individually and according to disease state. Adequate nutrition is always required in chronic diseases to improve Quality of life to meet specific need of patient in wound care, appropriate nutritional support is considered part and eating wholesome diet (*Pathya aahar*) in wounded not only enhance the healing process but also protect from infection and ultimately wound can heal uneventfully.

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**How to cite this article:** Naresh Kumar Ghodela, Vyasdeva Mahanta. Dietary Regimen for Wound Healing - An Ayurveda Perspective. J Ayurveda Integr Med Sci 2017;1:154-161.  
<http://dx.doi.org/10.21760/jajms.v2i1.7505>

**Source of Support:** Nil, **Conflict of Interest:** None declared.

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