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RESEARCH ARTICLE

DIETARY CONSIDERATIONS OF WOUND HEALING IN AYURVEDA

1,*Dr.Ganapathi Rao, I., 2Dr. Vijay Biradar, 3Dr. Ashok Naikar and 4Dr. Chandrakanth Halli

¹P.G.Scholar, P.G.Department of Shalya Tantra, N.K.J. Ayurvedic Medical College & P.G.Centre, Bidar

²Professor, P.G.Department of Shalya Tantra, N.K.J. Ayurvedic Medical College & P.G.Centre, Bidar

³Assistant Professor, P.G.Department of Shalya Tantra, N.K.J. Ayurvedic Medical College & P.G.Centre, Bidar

⁴Professor & H.O.D.P.G.Department of Shalya Tantra, N.K.J. Ayurvedic Medical College & P.G.Centre, Bidar

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ABSTRACT

Wound healing has been the burning problem in a surgical practice because of a remarkable increase in the number of traumatic cases. A wound causes a number of changes in the body that can affect the healing process, including changes in energy, protein, carbohydrate, fat, vitamin and mineral metabolism. Various ayurvedic literatures, particularly, Sushruta samhita, which is said to be an ancient textbook of surgery in Ayurveda, has mentioned about the diet for the person suffering from the wound, and the author said that diet plays a very important role in the wound healing process. Sushruta–The father of surgery has scientifically classified it in a systemic manner, whose wealth of clinical material and the principles of management are valid even today. Shalya Tantra (surgical branch in ayurvedic science) is one of the important branch of ayurveda, in which surgical and para-surgical techniques has described for management of various diseases. Vrana is the most important and widely described chapter of Shalya Tantra. Vrana (wound) is one of them, which have been managed by human being from starting of civilization. Under the circumstances, the first thing which the men came across was the injury from different sources which caused him the vrana. Vrana is seen as debilitating and scaring disorder, usually seen affecting the human being at any age. Well balanced nutrition plays an essential role in the wound healing.

INTRODUCTION

In this modern era, there is a remarkable increase in the number of traumatic cases, where the treating modalities like antibiotics, and local management is not sufficient for wound healing. Along with this, a well balanced dietetic pattern is needed. Diet and Health are more connected in the area of wound care. Balanced diet plays an important role in wound healing process, as it enables quick reaction to the wound or trauma itself, as well as enhanced the healing capabilities throughout the curative process. Wound management is a significant and growing health burden on the community (Arana *et al.*, 2004). Delayed wound healing and wound infection place a substantial financial burden on health care systems, as a result of increasing dependency and increased hospital admissions. Chronic wounds also have a very large social and quality of life impact on individuals and carers (Williams, 2003). Nutrition plays an essential role in wound healing and wound care practices, and nutritional support needs to be considered a fundamental part of wound management. Attending to nutrition in wound care is also cost-effective (Wallace, 1994).

***Corresponding author: Dr.Ganapathi Rao, I.,**
P.G.Scholar, P.G.Department of Shalya Tantra, N.K.J. Ayurvedic Medical College & P.G.Centre, Bidar.

Poor nutrition before or during the healing process may delay healing and impair wound strength, making the wound more prone to breakdown. Neglecting the nutritional health of an individual with a wound can compromise the entire wound management process (Wallace, 1994).

Patho-physiology of wound healing in Ayurveda

“The destruction/break/rupture/discontinuity of body tissue/part of body, is called “*Vrana* (Sushruta, 1988; Chaukhambha Orientalia Varanasi, 2002)”.

Factors influencing wound healing

Certain factors will influence the wound during the healing process, which is explained in *Sushruta* samhita. They are General factors include *vaya* (Age), *poshaka tatwa* (Nutrients), and the diseases like *madhumeha* (Diabetic), *paandu* (Anemia), etc. Local factors include *twak sthaan* (Position of skin), *shalya vastu* (foreign bodies), *bhoota sanghaata* (Infection), etc.

Healing process in open wound complete in 3 phases

In any type of open wound, three stages or phases are mandatory in healing process.

They are as follows.

- Inflammatory phase
- Collagen phase or Proliferative phase
- Maturation phase or regeneration phase/remodeling phase

Immediately following an injury, the healing process begins. A torn ligament or muscle is repaired, wounds heal, and bones mend. The healing process first involves getting rid of damaged tissue, then rebuilding healthy connective tissue in a step-by-step manner. The redness, swelling, heat and pain of inflammation are a natural part of the healing process. Many nutrients are involved in connective tissue repair and wound healing, such as amino acids, selective vitamins and minerals (Sushruta, 1988; Bucci, 1995).

Diet and wound healing-An ayurvedic aspect

Ahara/Pathya (Food/Diet) plays an important part for wound healing, which may not heal well, if we cannot eat food, which is not having proper calories of proteins, vitamins and minerals, etc. The diet of a patient entertaining an open wound should preferably consist of *laghu ahara* (light dietetic articles) in small quantities. Food always should be taken freshly cooked with fatty articles (especially cow ghee). Above all digestive upsets should be avoided. Dietetic constituents, as prescribed by *Sushruta*, should be advised for quicker healing and avoiding the complications. Hot liquefied food (like *manda/peya/vilepi type of gruel*) prepared from old rice, mixed with cow ghee (*Goghrita*) in small quantity with meat soup (*mamsa rasa*), a good diet for wounded by which quick healing of wound occurs.

Nutrients involved in connective tissue synthesis & wound healing

When there is damage to connective tissue, it is important to address the nutritional requirements for the synthesis of both the collagen fibers and the proteoglycans. **Collagen fiber** and proteoglycan synthesis are dependent on the supply of nutrient building blocks, such as amino acids and amino sugars. Vitamins and minerals are also needed for the many enzymatic reactions involved in connective tissue rebuilding. Some of the nutrients that are involved in connective tissue repair and wound healing are as follows.

Carbohydrates

Carbohydrate is a major source of calories for use by the body, and its availability is essential to prevent other nutrients (e.g. protein) from being converted into energy. It is not clear how carbohydrate deficiency influences wound healing, but increased carbohydrate intake provides energy that is essential for optimal healing (Williams, 2003). Carbohydrate sources include whole grain cereals, breads, rice and biscuits (Ressel, 1989).

Protein

Protein is essential for the maintenance and repair of body tissue. Depleted protein levels will cause a decrease in collagen development, slowing the wound healing process. Adequate protein levels will help achieve optimal wound healing rates (Williams, 2003; Edmonds, 2007; Ord, 2007).

Protein requirements should be calculated on an individual basis, and they should be monitored closely. This needs to happen along with the provision of calories, because if energy needs are not met the body will use protein for energy rather than for wound healing (Edmonds, 2007). In slow to heal/chronic wounds, a recommended daily intake of 1.5 g/kg/day will meet the protein needs of most individuals, but up to 3 g/kg/day may be appropriate for those with more severe wounds (Edmonds, 2007; Breslow *et al.*, 1993). Sources of protein include red and white meats, fish, eggs, liver, dairy products (milk, cheese, and yoghurt), soy beans, legumes, seeds, nuts and grains (Breslow *et al.*, 1993).

Protein-energy malnutrition (PEM) is the most serious type of malnutrition-when there is an inadequate or impaired absorption of both protein and energy. 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 (Ord, 2007; Hurd, 2004). This cascade demonstrates the severely negative impact poor nutrition can have on chronic wound healing.

Amino acids

The collagen fibers are made up of long chains of amino acids, of which one-third is glycine. Proline, hydroxyproline and hydroxylysine are also prevalent. Some proline and lysine residues become hydroxylated by certain enzymes to form hydroxyproline and hydroxylysine. This hydroxylation reaction requires a reducing agent, such as ascorbic acid and alpha-ketoglutarate as a substrate.

L-Arginine

L-Arginine is an amino acid that has several properties that enhance a number of the pathways involved in wound healing, such as its role in structural protein synthesis. As the body needs more protein during wound healing, the demand for normally nonessential amino acids, such as l-arginine, becomes essential. Dietary supplementation with arginine has been shown to enhance protein metabolism, helping to decrease muscle loss and collagen synthesis, which helps to increase the strength of the wound (Arana *et al.*, 2004; Wallace, 1994; Hurd, 2004; Langemo *et al.*, 2006). L-arginine is essential for the stimulation of the nitric oxide pathway, which is in turn important for collagen deposition in wound healing (Langemo *et al.*, 2006; Desneves *et al.*, 2005; Witte, 2002). L-Arginine supplementation has also been shown to enhance the immune system and improve the secretion of growth hormone and insulin that are also involved in wound healing (Wallace, 1994). People with pressure ulcers who have been treated with supplements containing arginine show a significantly improved rate of ulcer healing (Witte, 2003; Langemo *et al.*, 2006). L-Arginine is also effective in healing chronic ulcers in people with diabetes (ultimately helping to reduce leg amputations) (Arana *et al.*, 2004).

Fats

Fats, including mono and polyunsaturated fats, provide fuel for wound healing. Fats are a safe and concentrated source of energy.

Fatty acids are a major component of cell membranes, and demands for essential fatty acids increase after injury (Williams, 2003). Essential unsaturated fatty acids must be supplied in the diet as the body cannot synthesize enough for the needs of wounds (Williams, 2003). The benefit of omega-3-fatty acid supplementation in wound healing is still not clear, and there is some evidence this may reduce wound strength (Edmonds, 2007; Benati *et al.*, 2001). Good sources of fats to promote wound healing include meat, full-fat dairy products, such as milk, cheese, butter, cream, yoghurt, ice-cream and oils and fats used in cooking or as spreads.

Vitamin A

Vitamin A increases the inflammatory response in wounds, stimulating collagen synthesis. Low -A levels can result in delayed wound healing and susceptibility to infection (Williams, 2003; Hurd, 2004). It has also been shown that vitamin A can restore wound healing impaired by long term steroid therapy or by diabetes. Serious stress or injury can cause an increase in vitamin A requirements. Vitamin A is found in milk, cheese, eggs, fish, dark green vegetables, oranges, red fruits and vegetables (Breslow *et al.*, 1993).

Vitamin C

Vitamin C, or ascorbic acid, 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 fiber synthesis, a process vital for tissue repair and healing. Specifically, it is involved in the hydroxylation of proline to form hydroxyproline. Research by Patel (2005) 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 (Patel, 2005). Vitamin C is considered a very important water-soluble antioxidant. Additionally, vitamin C is capable of regenerating other antioxidants, especially vitamin E.

Vitamin E

Vitamin E is a major antioxidant and functions to quench free radicals in most tissues. They predominantly affect polyunsaturated fats that compose the lipid portion of cellular membranes. The main rationale for vitamin E supplementation is to reduce the damaging effects of free radicals (Patel, 2015). A number of conditions, such as chronic inflammatory disorders, injury to the central nervous system and connective tissue damage, are associated with free radical damage. It is thought that excess free radical production may also delay or prevent adequate healing. Vitamin E supplementation may reduce free radical damage and benefit wound healing and connective tissue repair.

Role of minerals

Zinc, Copper and Manganese for SOD induction: Superoxide dismutase (SOD) is an antioxidant enzyme. There are two forms of SOD: mitochondrial (contained within the mitochondria) and cytosolic (contained within the cytoplasm of the cell). Mitochondrial SOD is induced by manganese, whereas cytosolic SOD is induced by copper and zinc.

Copper/zinc SOD (CuZnSOD) and manganese SOD (MnSOD) protect tissues by converting damaging superoxide free radicals into hydrogen peroxide, which is further catabolized by catalase into water and oxygen. In order for the SOD enzymes to function, there needs to be an adequate dietary supply of copper, zinc and manganese. Dietary zinc sources include red meat, fish and shellfish, milk products, poultry and eggs. Research suggests that raising the intake of minerals needed for SOD induction may improve SOD activity (Crolle, 1980; Sato, 1988).

Iron

Iron is part of the system that provides oxygen to the site of the wound; therefore iron (Haemoglobin) deficiency can impair healing. Iron deficiency can also result in impaired collagen production and strength of the wound (Williams, 2003; Ressel, 1989; Breslow *et al.*, 1993). Iron absorption from non-meat sources can be enhanced with vitamin C (Breslow *et al.*, 1993). Zinc and iron compete for absorption, therefore, if someone is receiving supplements of both, the zinc and iron should be given with meals, but not at the same time (Kappus, 1992; Harris, 2004). Recommended iron intake for the general population is 8 mg/ day and for females aged 19-50 years, this increases to 18 mg/day (Harris, 2004). The best sources of iron in the diet are red meat, offal, fish, eggs, whole meal bread, dark green leafy vegetables, dried fruits, nuts and yeast extracts.

Energy

The main sources of energy for the human body and for wound healing are carbohydrates and fats. The main demand for energy from a wound is for collagen synthesis. Caloric needs for healing increase according to increasing size and complexity of the wound. For patients with wounds, energy requirements are estimated at 30-35 kcal/kg (Breslow *et al.*, 1993). Energy requirements vary according to gender, age, activity and clinical status.

Other important factor-Fluid maintenance

Hydration is important in wound healing, as dehydrated skin is less elastic, more fragile and more susceptible to breakdown. Dehydration will also reduce efficiency of blood circulation, which will impair the supply of oxygen and nutrients to the wound (Breslow *et al.*, 1993). One of the main risk factors for dehydration is poor oral intake. In long-term care, dehydration is one of the most common problems affecting good nutrition (Kappus, 1992; Harris, 2004). A general guide to providing fluids is 30-35 mL/ kg/day, with a minimum of 1500 mL or 6-8 cups/day (Prasad, 2006). Sources of hydration include water, juice, milk, ice-cream, yoghurt and soup.

Cow ghee (*Goghrita*)

Cow ghee gets absorbed easily and cross the cell membrane. It is also a concentrated source of energy having dietetic value, easier for digestion and absorption. Nutrients present in the ghee delivered to tissue easily. "Cow ghee is sweet in taste and cooling in energy, rejuvenating, good for the eyes and vision, kindles digestion, bestows lustre and beauty, enhances memory and stamina, increases intellect, promotes longevity, is an aphrodisiac and protects the body from various diseases" (NHMRC Nutrient Reference Values, 2005).

Cow ghee is used in most *ayurvedic* formulations. Cow ghee's regenerative properties are also useful for healing wounds and promoting the growth of healthy cells. This wound healing ability has also been clinically proven (Prasad, 2006; Demling, 2000). Cow ghee's cold, oily qualities help protect the body's mucous membranes and ensure its usefulness in any condition with burning sensations. Finally, on a practical level, ghee is rich in antioxidants, and hence, does not go rancid for a long time.

Pathya ahara as mentioned in Ayurveda (Diet to be taken/ followed)

Purana shastika Shaali (old stored rice), *Jaangala mamsa* (less fatty chicken), *Jeevanthi shaaka* (leafy vegetable called *Leptadenia reticulata*), *Tanduleeyaka shaaka* (red variety of Amaranthus leafy vegetable), *Vaastuka* (green leafy vegetable, ie. *Chenopodium album*), *Baalumulaka* (tender radish), *Vaartaka* (Brinjal), *Patola* (bitter variety of snakegourd), *Karavellaka* (bittergourd/ *momordica charantia*), *Daadima* (pomegranate), *Grutha bhrusta amalaki* (gooseberries fried in cow ghee), *Saindhva lavana* (potassium chloride), *Purana sarpi* (old stored cow ghee), *Mung* (Greengram/Phaseolus mungo), *Vilepi* (thick rice gruel), *Srutha jala* (cold water/potable drinking water). These vegetables and fruits are to be taken more during the wound healing process as mentioned in *Ayurveda*.

Apathya ahara as mentioned in Ayurveda (Diet not to be consumed)

Nava dhanya (newly harvested grain/cereals), *Masha* (blackgram), *Tila* (sesum oil), *Vishama bhojana* (intake of food at inappropriate time), *Ati-bhojana* (excessive eating), *Anista bhojana* (undesirable food), *Upavasa* (fasting), *Viruddha bhojana* (incompatible food), *Adhyashana* (eating when previous meal is not digested), *Kulaththa* (horsegram), *Nishpava* (variety of pea), *Amla-lavana-katu rasa* (sour/salty & pungent foods), *Vallura mamsa* (dried meat), *Shushka shaaka* (dried vegetables), *Vasaa* (animal fat), *Sheetodaka* (cold water), *Madya* (variety of alcohols) *Asuri* (mustard seeds), *Mulaka* (radish, which is not tender one) are *pooyavardhaka* (suppurative) and *Doshajanaka* (increases *tridosha/humour*). So these are to be avoided during the wound healing time as mentioned in *Ayurveda*.

DISCUSSION

Optimising nutrition is important to best practice care in wound management. The overall goal for the healthcare team should be to make sure the patient is in the optimum nutritional state to give wounds the best chance to heal (Williams, 2003). This can be achieved by providing the individual with adequate calories and nutrients, preventing protein/energy malnutrition and promoting wound healing (Breslow *et al.*, 1993). Cow ghee's (*Goghrita*) widespread prevalence in *ayurvedic* medicines and treatments is due to its beneficial effects on the digestion, absorption and delivery of *ayurvedic* herbs, as well as its own healing properties. When the digestive capacity (*agni*) and life-essence (*ojas*) are weakened, the *doshas* (*humours/tridosha*) are disturbed, causing disease. Cow ghee's actions on both *agni* and *ojas* are, hence, at the heart of all *ayurvedic* treatment. Cow ghee also

nourishes and regenerates the body and mind, improving the overall quality of treatment. Our body produces new cells and tissues in a day. If our body doesn't receive proper nutrition and the building material may delay the wound healing. Diet is considered as one of important factor for proper wound healing. Implementing the nutritional plan and providing appropriate nutritional support to the individual, helps to enhance the process of wound healing. There is a growing body of evidence and research demonstrating the vital role our diet plays in the healing of all types of tissue damage and inflammation. Eating a diet rich in fresh fruits, vegetables, seeds, legumes and whole grains will also help to ensure an abundance of phyto-chemicals, natural plant based chemicals that may promote health and healing. By combining knowledge of the wound healing process together with best practice provision of nutrition, healthcare professionals can help decrease the morbidity and mortality associated with chronic wounds, as well as reducing their cost and impact.

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