

## **Review Article**

# **Collagen Dressing For Thermal Burns**

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**Abstract:** Thermal burn injuries are very common due to accidents and suicidal attempts in low socio-economic population in our country. The mortality and morbidity caused by burns impose a great burden on the families of the victims and a great loss to the country due to lost working man-hours and the cost of treatment of injured patients. The expenditure involved in treatment of burn patients is a heavy burden on the exchequer. The deformities and disfigurement caused by the end result of wound healing has a profound bearing on the psychological aspect of the patients and affects the quality of life of the patient after the wound healing process. Wound healing is important with aim to minimize the deformity and a cosmetically acceptable scar. Early rehabilitation of the patients is the goal of the treatment protocols. This article is to review the use of collagen as a treatment modality in patients with burn injuries.

**Keywords:** Thermal burn injuries, Collagen.

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## **INTRODUCTION**

Collagen is the major insoluble protein (fibrous protein) in the extra-cellular matrix and in connective tissues. More than 80% of the skin is composed of collagen. It is also the main component of the ligaments and tendons.

In the early 1970's, John F. Burke and Ioannas Yannas developed a bio-compatible collagen matrix to improve wound healing. Over the years collagen implant solutions for a number of clinical applications include general surgery, burn surgery, neurosurgery, plastic and reconstructive surgery, oral surgery, and peripheral nerve and tendon surgery [1]. Collagen is a chemically distinct macro-molecular protein that aids wound healing

- Act as a substrate for hemostasis
- Chemotaxis to cellular elements of healing such as granulocytes, macrophages and fibroblasts
- To provide a scaffolding for more rapid transition to mature collagen production and alignment
- To provide a template for cellular attachment, migration and proliferation [2]

Burn injuries present a major public health problem in both adults and in children. The common causes of burn injuries are thermal burns, scalding or direct contact with hot objects. Burn injuries are common in children due to decreased awareness of the

potential danger, lack of prompt response and also the thinner skin tolerates less heat at a shorter duration before full-thickness injury occurs [3]. A deep partial-thickness has the capacity to heal when maintained moist wound bed, adequate circulation and in the absence of infection. In the absence of the above factors a partial-thickness burn wound converts into a full-thickness wound [4]. Ideal approach to the care of partial-thickness burns is to provide optimal conditions for wound protection and minimize the pain.

Before 1980s, the treatment protocol was cleansing, debridement and application of antimicrobial agents such as silver sulfadiazine, sulfamylon, or bacitracin. With daily change of dressing the wounds healed usually in 10 days to 21 days. Dressings with various degrees of occlusion using Duoderm, Opsite and Xeroform were very expensive and painful on application. Biobrane, a synthetic skin substitute was developed as an alternative to the available biological temporary skin substitutes such as pig skin, amnion and cadaver skin.

Different collagen-based products including Biobrane, Integra and beta glucan collagen matrix (BGC) are used in the wound care protocols.

## **COLLAGEN**

Collagen is a natural component of the dermal matrix produced by fibroblasts and functions as protective scaffolding for migrating epithelial cells in the regenerating skin. Beta glucan stimulates

macrophages that are essential in the inflammatory phase of healing by providing phagocytosis and secretion of chemokines that promote formation of new tissue [5]. Collagen gives the skin its tensile strength and is essential for all phases of wound healing. It attracts fibroblasts and keratinocytes to the wound and encourages debridement, angiogenesis and reepithelialization.

Collagen dressings stimulate new tissue growth and encourage deposition and organization of newly formed collagen fibers and granulation tissue in the wound bed. The matrix metalloproteinases (MMPs) are zinc-dependent endopeptidases. They are capable of degrading all kinds of extracellular matrix proteins. The collagen in the collagen based dressings bind to the MMPs found in the extracellular fluid of the wounds and is an alternative collagen source, leaving the body's natural collagen available for normal wound healing [6].

#### Indications for collagen dressing

- Partial-and full-thickness wounds.
- Wounds with minimal to heavy exudates
- Skin grafts and skin donor sites
- Second degree burns
- Granulating or necrotic wounds
- Chronic nonhealing wounds



**Fig. 1: Child with scald burn injury comfortable with collagen application**

#### Contraindications

- Third degree burns
- Patient sensitivity to bovine, porcine or avian products
- Wounds covered with dry eschar.

A variety of topical formulations are available such as freeze-dried sheets, pastes, pads, powder and gels. Some dressings include alginates or even antimicrobial additives.

#### Burn wound healing

Wound care, good nutrition, maintenance of function, positive attitude and co-operation of the patient is the aim of the whole burn team to achieve

- Promote spontaneous healing
- Prevention of infection
- Prevent further tissue loss
- Identify early the need for surgery
- Alleviate pain and anxiety of the patient.

#### Ideal burn wound dressing

Various biologic, biosynthetic and synthetic dressings are used in burn wounds based on the condition of the wound bed and the inherent properties of the dressings.

An ideal burn dressing is characterized by the following

- Protect the wound from physical damage and micro-organisms
- Be comfortable, compliant and durable
- Be non-toxic, non-adherent, and non-irritant
- Allow gaseous exchange
- Allow high humidity at the wound
- Be compatible with topical therapeutic agents
- Be able to allow maximum activity for the wound to heal without retarding or inhibiting any stage of the process [7].

#### Indications for collagen sheet dressing in burns patients

- First degree burns
- Second degree burns
- Non-infected or pre-cleaned 2<sup>nd</sup> degree burns.
- For radiation burns on the face.

#### Contraindications

- Allergic to the collagen preparation.
- Third degree burns.

#### Availability

Synthetic skin substitutes are very expensive and may not be available in all centers treating burn patients. The collagen sheets are freely available, less expensive and can be used even in facilities where burn units are not available and can be monitored by health-care providers locally available. Collagen sheets are produced from bovine tissues comprising mostly type I and III collagen, packed in a neutral glass vial containing sterile preservative mixture of isopropyl alcohol and water sterilized with ethylene oxide. Collagen sheets are available in different sizes for clinical application. Collagen sheets are available in freeze dried form to avoid treatment of collagen membrane in normal saline before application. It is available as meshed collagen membrane in wet form, porous collagen dressing and also as collagen film dressing. Recently sterile medicated collagen dressings are also available.

### Basic principles of treatment with collagen

- Collagen is a natural, easily available, ready to use, non-immunogenic and non-pyrogenic material.
- Best possible physiological interface between the wound surface and the environment and facilitates the body's reparative and immune systems to function effectively [8].

### METHODOLOGY

#### The procedure of collagen sheet application in burn patients

The affected area is thoroughly cleaned for removal of any external contamination preferably under anesthesia in a strict aseptic condition. Collagen sheets are washed and rinsed in normal saline before application to remove all traces of preservation fluid. Sheets are applied firmly over the burn areas. Avoid over stretching of the sheet. Make sure to remove all air bubbles between the wound and the collagen sheet. Use a dryer to ensure adhesion of the collagen sheet to the burn wound. Circumferential burn areas especially in the extremities when dressed with collagen sheets must leave a linear gap in the entire length of the extremity to give an allowance for the edema of the extremities to avoid compression effect.



Fig. 2: The procedure of collagen application

Patients are followed in the postoperative period with intravenous fluids and antibiotic and analgesics as indicated depending on the percentage of total body surface area involved. Any collection of fluid underneath the collagen sheet must be let out by making small nicks in the collagen sheets. Patients with small areas of collagen sheet application can be discharged and followed in the outpatient department. The collagen sheet dries up in the periphery and gets lifted up, is clipped off gradually till the wound heals completely. This takes from 10 days to 14 days. After complete healing occurs scar management should begin as per the protocols followed in the unit.

No known complication of collagen in burns patients is noted except inflexion complications following delayed application in burn patient. The small patches of third degree burns in otherwise superficial burn wounds may go in for delayed healing. Rarely the applied collagen necessitates removal for infected material collection under the collagen sheet. Application of collagen in heavily exudating wound should be delayed for a few hours to avoid such complications.



Fig. 3: Follow-up of the same patient. Note the good healing in face. There were patches of deep burns in the extremities

### DISCUSSION

Bovine collagen is very similar to human collagen prepared from bovine collagenous tissues with a series of chemical and enzymatic procedures followed

by chemical cross-linking and sterilization. The collagen sheet is retained in the tissue and gradually absorbed by inflammatory cellular activity. The fibrous tissue is then replaced by fibroblasts. Granulation tissue

developed at a normal rate and the cellular events are similar to the events occurring in normal wounds. Desamidation of collagen makes it a useful and important bio-polymer in the field of bio-material engineering. Desamidation results in a collagen with improved solubility as well as swelling properties, which are the prerequisites for a bio-material [9]. Desamidation collagen has high viscosity and very high hydroxyproline content, like native collagen [10]. Collagen sheets are very useful in first-and second degree burns [9].

#### Advantages

- Cost of treatment comes down
- Pain associated with dressing can be avoided
- Especially in children the trauma of dressing is avoided
- Protects against infection
- Avoids evaporative water loss
- No threat of HIV or Hepatitis infection as bovine material is obtained from countries free of bovine spongiform encephalopathy(BSE)
- Long shelf-life(5 years) under normal storage conditions
- Low antigenicity
- Ensures non-toxicity to the biological environment where it is applied.

#### CONCLUSION

In conclusion, the collagen sheets used in selected patients with superficial burns has several advantages over the conventional dressing method. This method is easy to perform, no need for frequent dressing changes, prevents evaporative skin loss of water and electrolytes and free from pain of frequent dressing change especially in children. The chances of infection is also minimal since the collagen forms a protective cover. The wound healing process is quick and the scar formed is cosmetically acceptable.

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