

## Assessment of the Effectiveness of the Novel Technique of Collagen Application Over Meshed Split Thickness Graft for Wound Coverage: A Prospective Study

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### Abstract

**Aim:** To study the advantages of a novel technique of using collagen sheet over meshed split thickness graft for wound coverage.

**Methodology:** A prospective study was conducted at Department of general surgery at Sheikh Bhikhari Medical College and Hospital, Hazaribagh, Jharkhand, India. A total of 25 patients were part of this study intending to follow each patient at least for a minimum of 6 months postoperatively. All patients underwent relevant routine investigations. Patients were regularly evaluated for postoperative complications and outcomes. Patients were asked to provide their objective pain assessments on a Pain scale from '0-10' at regular intervals. For scar assessment, Vancouver Scar Scale (VSS) was used. Patient's overall satisfaction was also accounted.

**Results:** Out of 25 patients, 15 (60%) were males and 10 (40%) were females. The majority of patients in the study were in 3rd, 4th and 5th decades. 11 (44%), 8 (32%), and 6 (24%) patients belonged to 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decade of life respectively. The lower extremity (11, 44%) was the most common area requiring skin grafting, followed by the trunk (9, 36%) and upper extremity (5, 20%) area. The mean VSS score of 25 patients at the end of 1, 2, 4 and 6 months was 0.30, 0.48, 1.04 and 2.17. Out of 25 patients, 1 patient had score more than 4 at the end of 6 months indicating hypertonic scar.

**Conclusion:** With satisfying results obtained in this study, we acknowledge collagen for its ease of use and cost-effectiveness. Furthermore, we consider it effective because of the promotion of epithelialization, reduction of pain and limited complications.

**Keywords:** Collagen, grafting, wound healing, epidermis, epithelialization.

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### Introduction

A split-thickness skin graft (STSG), by definition, refers to a graft that contains the

epidermis and a portion of the dermis, which is in contrast to a full-thickness skin graft (FTSG) which consists of the

epidermis and entire dermis. Unlike flaps, skin grafts do not have their own blood supply, so they must rely on a well-vascularized wound bed for graft in-growth. Split-thickness skin grafts are obtainable from multiple sources (autograft, homograft, allograft, or xenograft), multiple anatomical locations, and in various thicknesses. Split-thickness skin grafts classify according to their thickness into thin STSGs (0.15 to 0.3mm), intermediate STSGs (0.3 to 0.45mm), and thick STSGs (0.45 to 0.6mm) [1,2].

Split-thickness skin grafts contain the epidermis and a portion of the dermis. The epidermis is the outermost layer of skin, comprised primarily of keratinocytes. The epidermis is a thin, semitransparent layer that provides a significant barrier function. The dermis is the fibrous layer below the epidermis composed of collagen, glycosaminoglycans, and elastin. Split-thickness skin grafts play an integral part of the reconstructive ladder. They are indicated when simpler methods of wound closure will not suffice, such as healing by secondary intention, primary closure, or negative pressure wound therapy [3].

To minimize scar formation and to accelerate healing time, different techniques of skin substitution have been introduced in the last decades [4]. Currently, bilayer concept of wound coverage in which both epidermal and dermal analogs are used is widely accepted [5]. In case of insufficient donor skin, after harvesting, STSG may be meshed to expand the graft up to 9 times the donor site surface area depending on the mesher. Meshing a graft enables it to conform to convoluted wound surfaces. It also allows the drainage of fluid through the windows. However, meshed grafts carry some disadvantages: Widely expanded meshed grafts are more fragile. Expansion slits or windows have to heal by re-epithelialization, leading to significant contraction and poor cosmesis. Larger

expansions have delayed epithelialization [6].

Collagen sheets are produced from bovine tissues comprising mostly type I and III collagen, which have been found important for wound healing. Previously, collagens were thought to function only as structural support. Nevertheless, current concepts with the advance in molecular mechanics, it has been found that collagen holds the key to control many cellular functions, including cell shape and differentiation, migration, and synthesis of several proteins.[7] Dressings containing collagen plays a vital role in the management of wounds where healing is delayed.

### Materials and Methods

A prospective study was conducted at Department of general surgery at Sheikh Bhikhari Medical College and Hospital, Hazaribagh, Jharkhand, India. A total of 25 patients were part of this study intending to follow each patient at least for a minimum of 6 months postoperatively. All patients underwent relevant routine investigations. Patients were regularly evaluated for postoperative complications and outcomes.

Procedure: Prior to surgery, antibiotics were administered. General anesthesia was also given. The use of a tourniquet was also indicated in case of surgery of extremities. Electrocautery and adrenaline-stimulated solutions were used to prevent bleeding. The thickness of the STSGs varied from thin to intermediate depending on the reconstructive needs. For donor site dressing, collagen sheets were used. The meshed graft was placed over the raw area and contoured to the irregular surface with the help of forceps and saline gauze so that it was wrinkle-free, not stretched and without 'tenting'. It was then secured with staples. Collagen was washed with normal saline for six to ten minutes and placed in direct contact over the graft in such a way to cover and extend beyond the graft margin. Over this, low adherent, paraffin

impregnated gauze was used, followed by Betadine cotton and cotton pads.

Patients were asked to provide their objective pain assessments on a Pain scale from '0-10' at regular intervals. Analgesics were administered only on request. On the 5th postoperative day (POD), the first dressing change was done and was inspected for infection and haematoma formation. Subsequently, dressing changes were done every 3rd day with sterile precautions. Graft loss, if present, was duly

noted, marked on a graph sheet, and the percentage was calculated. Patients were followed thereafter, at 2 weeks, 1, 2, 4 and 6 months. Patients were advised regular use of compression/pressure garments, massaging of the grafted area with emollients (aloe vera, cocoa butter, paraffin) and sun protection. For scar assessment, Vancouver Scar Scale (VSS) was used. Patient's overall satisfaction was also accounted. Statistical analysis of the data thus obtained was done.

Vancouver Scar Scale		
Scar Characteristics		Score
Vascularity	Normal	0
	Pink	1
	Red	2
	Purple	3
Pigmentation	Normal	0
	Hypopigmentation	1
	Hyperpigmentation	2
Pliability	Normal	0
	Supple	1
	Yielding	2
	Firm	3
	Ropes	4
	Contracture	5
Height	Flat	0
	<2 mm	1
	2 – 5 mm	2
	>5 mm	3
<b>Highest Score</b>		<b>13</b>

## Results

Out of 25 patients, 15 (60%) were males and 10 (40%) were females. The majority of patients in the study were in 3rd, 4th and 5th decades. 11 (44%), 8 (32%), and 6

(24%) patients belonged to 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decade of life respectively. The lower extremity (11, 44%) was the most common area requiring skin grafting, followed by the trunk (9, 36%) and upper extremity (5, 20%) area.

**Table 1: Demographic details of recipient and donor skin graft site details**

Variable		Number	%
Gender	Male	15	60
	Female	10	40
Age	3 <sup>rd</sup> decade	11	44
	4 <sup>th</sup> decade	8	32
	5 <sup>th</sup> decade	6	24
Skin graft site	Lower extremity	11	44
	Upper extremity	5	20
	Trunk	9	36

A numeric rating scale (NRS-11) was used to score pain. Patients were administered analgesics, Inj. Diclofenac, only on request. None of the patients needed analgesics after 2nd postoperative day. None of the study patients had postoperative complications such as seroma, haematoma, infection. Graft loss was seen in 1 patient only. These patients under- went regular dressing with no adjuvant procedures.

Vancouver scar scale (VSS) was used to determine the outcome of the grafted area. A score of more than 4 was considered a hypertrophic scar. The mean score of 25 patients at the end of 1, 2, 4 and 6 months was 0.30, 0.48, 1.04 and 2.17. Out of 25 patients, 1 patient had score more than 4 at the end of 6 months indicating hypertonic scar.

**Table 2: Pain Score of patients**

Pain Score	No. of Patients				
	Immediate Post-Op	1st POD	2nd POD	4th POD	5th POD
<b>0 (No Pain)</b>	16	15	19	23	25
<b>1 – 3 (Mild Pain)</b>	6	6	5	2	0
<b>4 – 6 (Moderate Pain)</b>	3	4	1	0	0
<b>7 – 10 (Severe Pain)</b>	0	0	0	0	0

## Discussion

Skin is the largest organ in the body and covers the body's entire external surface. A skin wound results from the breakdown of the epidermal layer integrity [8]. Wound healing begins immediately into four phases after the injury: hemostasis, inflammation, proliferation, and Remodeling. Any disruption leads to abnormal wound healing [9].

A split-thickness skin graft, also known as a partial-thickness skin graft, is a portion of skin that contains both epidermis and varying portions of the dermis. Thin grafts, such as split-thickness skin grafts require little revascularization during the healing

process and therefore have a greater chance of graft survival than full-thickness grafts. Alternatively, full-thickness grafts are likely to retain the color and texture of the donor skin. Thus, split-thickness skin grafts are more applicable when the desired therapeutic goal is the restoration of function, whereas full-thickness grafts may be more suitable when cosmetic outcome is a central concern. Wilkinson (1997) contends that SSG's speed up the healing time of large areas of skin loss, whilst protecting the underlying structures and reducing the risk of infection [10].

Split-thickness skin grafts play an integral part of the reconstructive ladder. They are

indicated when simpler methods of wound closure will not suffice, such as healing by secondary intention, primary closure, or negative pressure wound therapy [11]. A prerequisite of skin grafting includes available donor sites and recipient sites that are well-vascularized and clean. Split-thickness skin grafts are indicated in acute skin loss (burn wounds, traumatic wounds, infection), chronic skin loss (leg ulcers), and as adjuncts to other procedures (to cover a muscle flap).

According to study by Donaghue et al., collagen type 1 accelerates tissue remodeling without causing irritation and basically reduces post-treatment care requirements compared to regular dressings [12]. Chung J et al., have researched on the ability of collagen in stopping bleeding, thence, no incidence of hematoma formation in our study can be attributed to this [13]. Collagen over skin bridges of the graft remains intact and can be rinsed away with saline irrigation after its purpose is served. Hence, removal of the dressings does not interface with healing granulation tissue, nor does it cause pain to the patient.

Scar assessments can be objective and subjective. Subjective assessments are observer dependent, but objective assessment provides a quantitative measurement of the scar. Ideally, scar measuring devices for objective assessment should be non-invasive, easy to use, accurate and reproducible. The final scar outcome in our study was assessed by means of the Vancouver Scar Scale (VSS), which takes into account vascularity, pigmentation, pliability and height of the scar. The VSS was first described by Sullivan in 1990 and is the most widely used post-burn scar assessment method [14]. 0 is the lowest, and 13 is the highest score awarded. A score of more than 4 was considered as a scar to be hypertrophic. In our study, the mean score of 25 patients at the end of 1, 2, 4 and 6 months was 0.30, 0.48, 1.04 and 2.17. Out of 25 patients, only

1 patient had score more than 4 at the end of 6 months indicating hypertonic scar.

### Conclusion

With satisfying results obtained in this study, we acknowledge collagen for its ease of use and cost-effectiveness. Furthermore, we consider it effective because of the promotion of epithelialization, reduction of pain and limited complications.

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