"COMPARISON OF PARAFFIN GAUZE DRESSINGS VERSUS SILVER IMPREGNATED DRESSINGS FOR DONOR SITE OF SPLIT THICKNESS SKIN GRAFTING"

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SDUAHER

DISSERTATION SUBMITTED TO

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH,

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MASTER OF SURGERY

IN

GENERAL SURGERY

Under the guidance of

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MAY 2018

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Dr. K VIKAS SANKAR

LIST OF ABBREVIATIONS USED

Abbreviation	Full Form
mm	Millimeter
%	Percent
sq. m	Square meter
DEJ	Dermo epidermal junction
CD4+	Cluster differentiation 4 positive
CD8+	Cluster differentiation 8 positive
SSG	Split skin grafting
FTSG	Full thickness skin graft
STSG	Split thickness skin graft
#	Number
VAS	Visual analogue scale
0	Degree
BC	Before Christ
Ag+1	Ionized silver
RCT	Randomized controlled trial
AgNaCMC	Carboxy methyl cellulose dressing containing ionic silver
SSD	Silver sulphadiazine
LC SSD	Lipido colloid coating impregnated with Silver
TBSA	Total body surface area
Ag0	Inactive silver
Ppm	Parts per million

ABSTRACT

Background:

Split thickness skin grafting is a commonly used reconstructive procedure but is associated with a large variation regarding the management of the donor site. Several types of dressings are available for the donor site and are in use, like paraffin gauze dressings, hydrocolloid dressings, silver impregnated dressings, poly-urathane film dressings, cellulose based dressings and bactigras(tulle gras) dressings. Among these paraffin gauze dressings are routinely used. Recent studies show that silver impregnated dressings reduce pain and also epithelisation time of donor site in Split thickness skin graft patients. Since it will be advantageous to adopt the better of the two techniques in the future, an attempt was made in this study to compare the two techniques.

Objectives:

- To use paraffin gauze dressings for donor sites of Group 1 patients.
- To use silver impregnated dressings for donor sites of Group 2 patients.
- To compare the epithelisation and score of pain with use of paraffin gauze dressings and silver impregnated dressings using clinical experience and visual analogue scale respectively.

Methods:

60 patients undergoing split thickness skin grafting fulfilling the exclusion criteria in department of surgery at R.L. JALAPPA HOSPITAL, TAMAKA, KOLAR were divided into two groups of 30 each. Paraffin gauze dressings are used in one group and silver impregnated dressings are used in another group for the donor sites and results were compared.

Results:

The median VAS score in Paraffin Gauze on Day 5 was 8 and on Day 10 was 3. Median VAS score in Silver impregnated group on Day 5 was 5 and on Day 10 was 1. This difference in median VAS score between two groups was statistically significant.

The median score of epithelisation in Paraffin Gauze group was 3 on day 14 and in Silver impregnated group was 4 on day 14. This difference in grade of epithelisation on day 14 between two groups was statistically significant.

Conclusion:

Inspite of silver impregnated dressings being expensive compared to paraffin gauze dressings, silver impregnated dressings are preferable for the donor sites of split thickness skin grafting over paraffin gauze dressings as they reduce the duration of hospital stay as well as the use of analgesics, hence are economical to the patients in the long run.

Key words: Silver impregnated dressings, Paraffin gauze dressings, Donor site of SSG.

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INTRODUCTION

Split thickness skin grafting is a commonly used reconstructive procedure. This is because of the notion that "Skin is the best dressing that can be done". But the management of the donor site is still under debate[1].

The discomfort after STSGs is more near the donor site than at the grafted site as there is exposure of the nerve endings at the donor site which leads to pain, serosangineous discharge and itching at this site. Pain at the donor site is the most common cause of morbidity after STSG.

Usually the donor site takes 7-21 days for re-epithelisation depending on the depth at which the graft was taken. The other factors influencing the healing time being local infection, nutritional status of the patient and such. Initially the donor sites used to be dressed tightly and left alone till the epithelisation is complete and the dressing falls off on its own. With the advent of different types of dressings and also transparent dressings the management of the donor site has changed drastically and is subject to the surgeon's choice.

The most common sites chosen as donor site are the thigh followed by arm. Thigh provides lot of surface area from which graft can be harvested and the skin in this area is concealed by clothing. For these reasons, thigh is the most preferred site for harvesting a graft. Several types of dressings are available for the donor site and are in use, like paraffin gauze dressings, hydrocolloid dressings, silver impregnated dressings, poly-urethane film dressings, cellulose based dressings and medicated tulle gras dressings. The mesh paraffin gauze dressing has for years been the primary choice of surgeons for the coverage of split-skin donor sites[2], given its ease of application, comfort, low risk of infection, and minimal cost[3-6].

Paraffin gauze dressings are tulle gras dressings coated with soft paraffin jelly. These allow the exudate from the wound to drain freely into the absorbent secondary dressing. They are not medicated and can be used with the topical medication of choice. Medicated tulle gras dressings are premedicated dressings which can be used prophylactically or in specific infections according to the culture sensitivity from the wound.

Hydrocolloid dressings have an active surface treated with a gel-forming substance consisting of pectin, carboxy-methylcellulose, polymers and other adhesives. They are opaque, flexible and adhere to the skin. When in contact with wound exudate, the polymers absorb the fluid and swell, forming a gel which is confined within the structure of the material. Hydrocolloid dressings are most appropriate for non-infected wounds with low to moderate discharge, necrotic or granular wounds. These dressings are impermeable to bacteria and adhere to normal skin only. Thus they do not interfere with healing process.

Poly-urethane film dressings are transparent film dressings which are waterproof and impermeable to bacteria and contaminants. Although these dressings cannot absorb fluid, they are permeable to moisture allowing one-way passage of carbon dioxide and excess moisture vapor away from the wound.

Cellulose based dressings at a microscopic level closely resemble the body's own collagen. The nonwoven ribbons of microbial cellulose closely resemble the body’s extracellular matrix yielding a high vapor transfer rate while providing a normal matrix covering the entire wound bed. The result is a fluid balance and mechanical cellular matrix which bridges the wound bed, thus promotes

distribution and concentration of growth factors and nutrients needed for healing, while protecting the wound from environmental contamination.

Silver impregnated dressings have been used to prevent and treat wound infections since a long time as the active agent, silver ions are potent antimicrobials while being non toxic to the human tissue. These dressings give protection to the wound site, prevent infection and maintain moist wound environment.

Among all those mentioned above, paraffin gauze dressings are most widely used. These dressings cost less to the patient but do not provide benefit against any of the complications while Silver impregnated dressings are hypothesised to reduce the pain, help in faster epithelisation as well as provide protection against infection of the donor site.

In the present study we compared postoperative pain and epithelisation with paraffin gauze dressings and silver impregnated dressings to know which among the two is more beneficial to the patient.

OBJECTIVES OF THE STUDY

- To use paraffin gauze dressings for donor sites of Group 1 patients.

- To use silver impregnated dressings for donor sites of Group 2 patients.

- To compare the epithelisation and score of pain with use of paraffin gauze dressings and silver impregnated dressings using clinical experience and visual analogue scale respectively.

REVIEW OF LITERATURE

ANATOMY OF SKIN[7]

EMBRYOGENESIS:

Skin is the largest organ of our body and protects the other organs from outside pathogens and also helps in thermoregulation. Most of the skin and its appendages are derived from ectoderm whereas the connective tissue of the skin is derived from mesoderm. At the 4th week of gestation, the surface ectoderm forms the basal layer. The proliferation of cells continues and forms the periderm and intermediate layer at about 11 weeks of gestation. Stratification starts at this stage and at around the 24th week, the development is complete along with the keratinisation.

The epidermal appendages of the skin like hair, nails and mammary glands develop from the ectoderm and melanocytes are derived from neural crest while dermis and hypodermis are derived from the mesoderm.

The melanoblasts or precursors of melanocytes are present in the upper dermis by 6th week of gestation and their migration begins. They migrate into the epidermis and from there into the hair follicle bulge where the migration is complete at around 10weeks of gestation.

Thus the skin basically is made up of epidermis which varies in thickness of less than 0.1mm on the eyelids to about 1mm in acral region, dermis which varies from 1mm on the face to about 4mm on the back and the subcutaneous fat which varies according to the site and also from person to person.

ANATOMY:

Skin is the largest organ of the body and constitutes about 8% of the total body mass and has surface area of 1.2 to 2.2 sq. m. The thickness of the skin varies from 1.5 mm to 4mm. The basic structure of skin consists of epidermis and basement membrane zone overlying dermis and subcutaneous fat.

Epidermis – The major components of epidermis include keratinocytes, melanocytes and Langerhans cells. Keratinocytes are classified by their location and degree of differentiation. These several distinct layers of cells are arranged in 2 zones.

1. Deeper zone – Zona germinativa: Stratum basale, Stratum spinosum, Stratum granulosum.
2. Superficial zone – Zona cornea : Stratum lucidum , Stratum corneum.

The basal cell takes 14 days to reach the stratum corneum and another 14 days to desquamate under normal conditions.

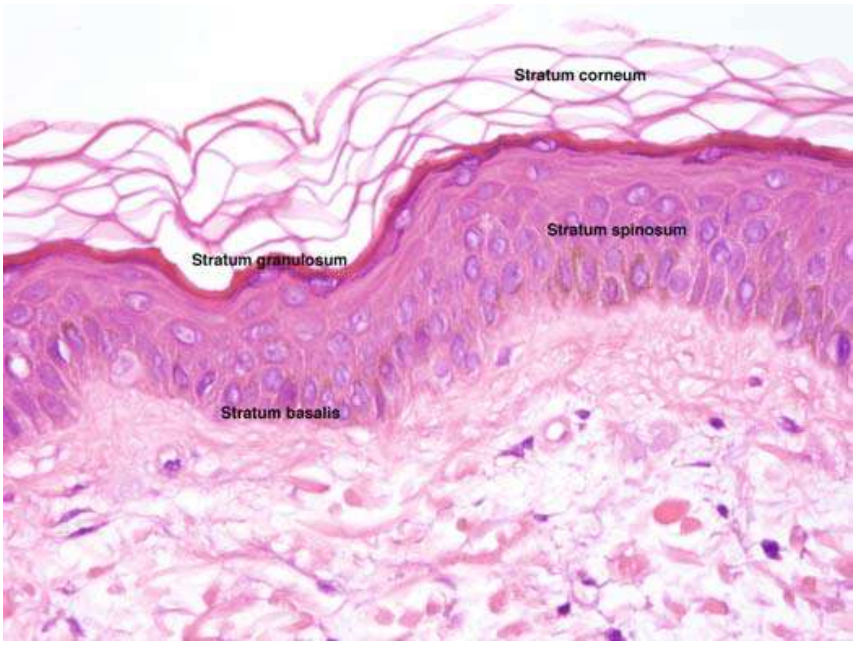


Fig. 1 Epidermis showing the normal keratinocyte maturation

1. **Stratum Basale**

Cells in the basal layer are stem cells which proliferate. Some cells proliferate rapidly like the cells at the base of rete ridges while others proliferate slowly like those at tips of dermal papillae. Basal cells produce low molecular weight keratins (5 and 14).

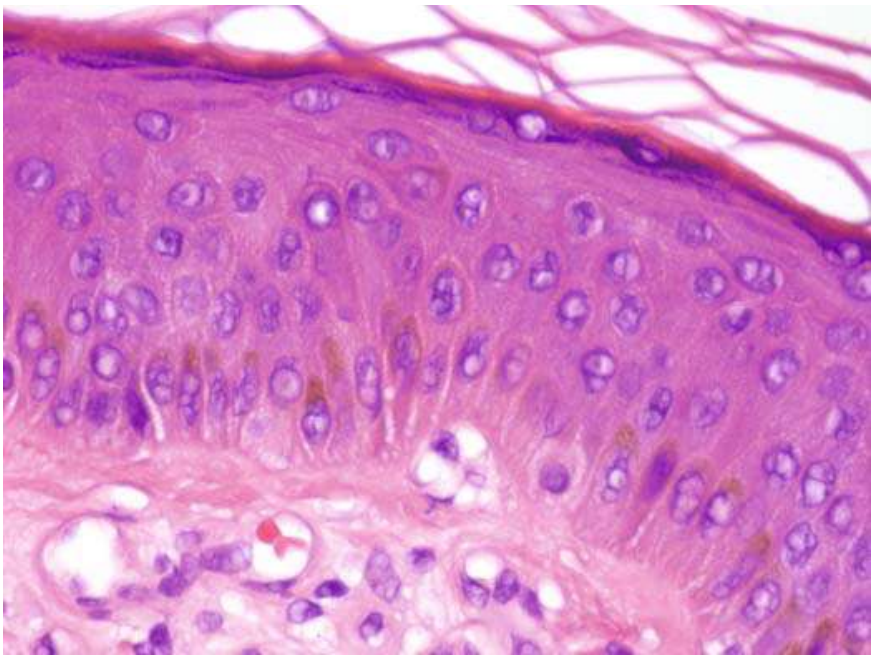


Fig. 2 The basal layer demonstrates pigment-laden keratinocytes and vacuolated melanocytes

2. Stratum Spinosum

The spinosum layer has keratinocytes that have abundant eosinophilic cytoplasm. This is the zone of maturation. Keratin production switches from lower molecular weight keratins (5 and 14) to higher molecular weight keratins (1 and 10). Nuclear to cytoplasmic ratio becomes progressively smaller in these layers.

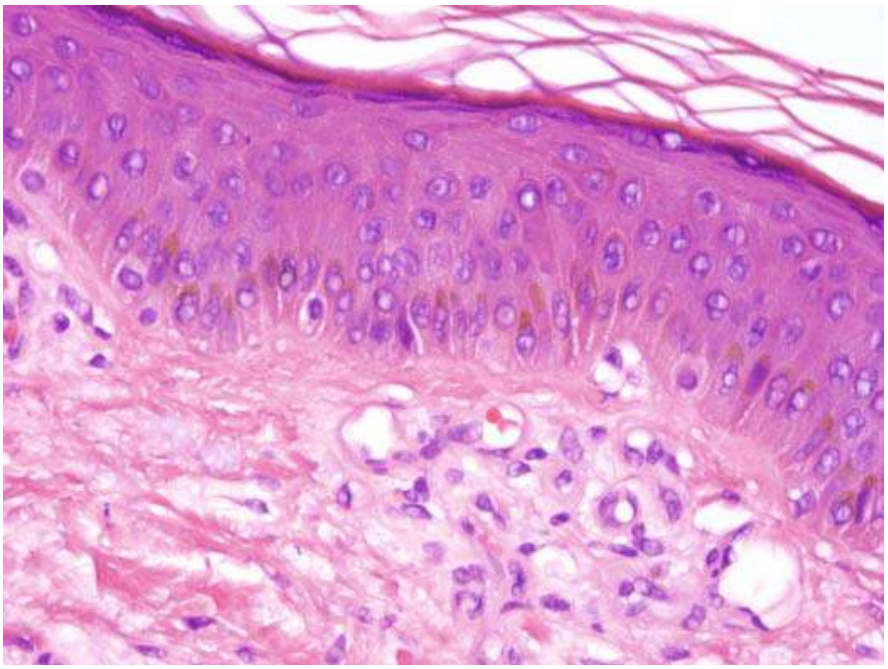


Fig. 3 The spinosum layer keratinocytes have abundant eosinophilic cytoplasm. The stratum granulosum demonstrates keratinocytes with abundant keratohyaline granules.

3. Stratum Granulosum

This layer is characterized by keratinocytes containing the keratohyaline granules as shown in Fig. 3 which are filled with histidine- and cysteine-rich proteins that appear to bind the keratin filaments together. Therefore, the main function of keratohyalin granules is to bind intermediate keratin filaments together.

4. Stratum Lucidum

Stratum lucidum is a thin layer of dead skin cells in the epidermis. It is named so because of its translucent appearance under a microscope. It is readily visible by light microscopy only in areas of thick skin, which are found on the palms of the hands and the soles of the feet. The keratinocytes of the stratum lucidum do not have distinct boundaries. These keratinocytes are filled with an intermediate form of keratin.

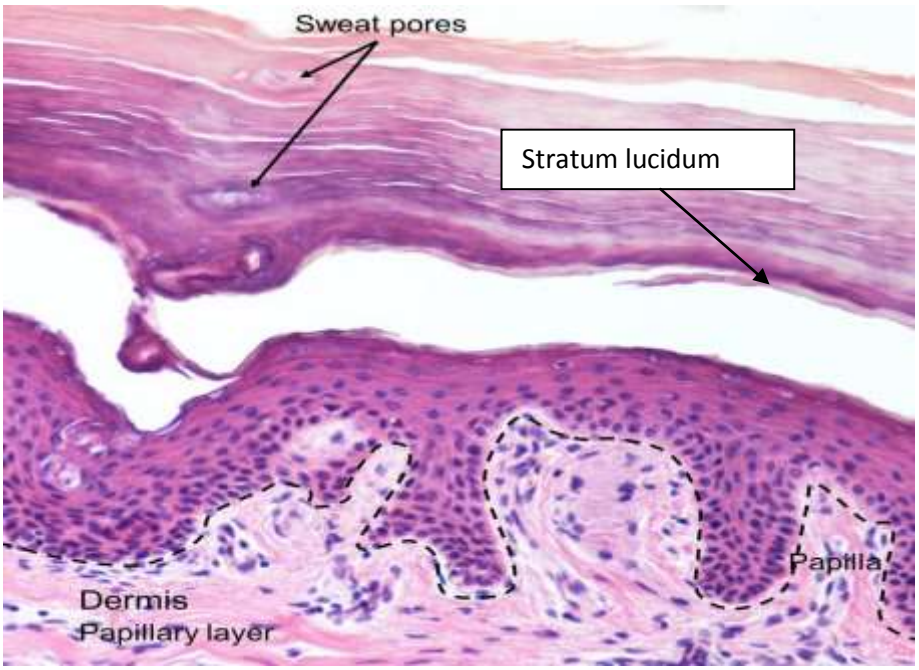


Fig. 4 The lucidum layer containing keratinocytes with no distinct boundaries

5. **Stratum Corneum:**

Keratinocytes are arranged in a basket- weave pattern. There is increased lipid concentration in the cytoplasm (Odland bodies). The keratinocytes lack nuclei in this layer as they are normally extruded before they reach the stratum corneum.

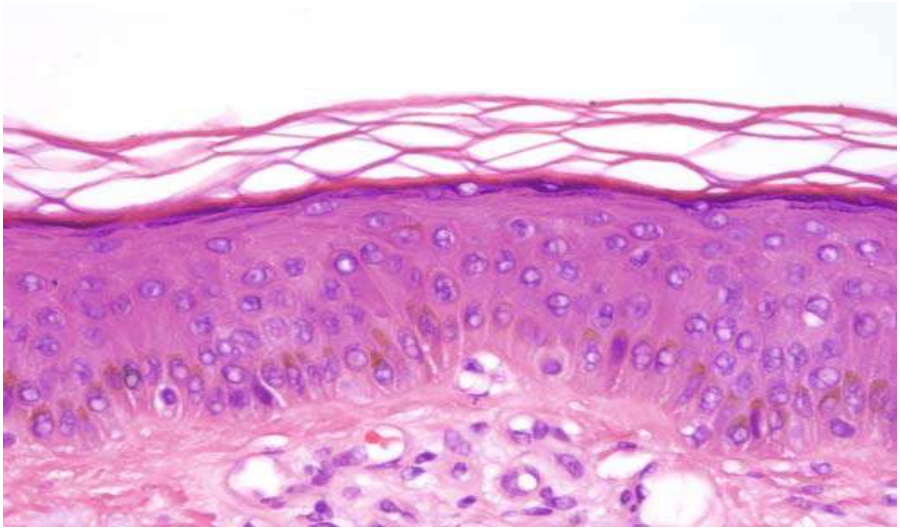


Fig. 5 The stratum corneum demonstrates basket-weave pattern

Dermis - The dermis is divided into a thin superficial area called the papillary dermis and a thicker deep area rich in collagen bundles called the reticular dermis. They are composed of cellular, fibrous and ground substance components. Fibres include collagen, reticulin and elastic fibres. Collagen fibres provide the skin with the bulk of its tensile strength, whereas elastic fibres impart properties of flexibility to the skin. Dermis is exceedingly thin and delicate in the eyelids, scrotum and penis, anterior of neck, flexor aspect of arm and forearm, cubital and popliteal fossae. Specialized extensions of the epidermis into the dermis constitute the appendages. These are hair, sebaceous glands and sweat glands (apocrine and eccrine). The dermis consists of the following components.

1. Vasculature
2. Connective tissue
    - Collagen
    - Elastic tissue
3. Nerves
4. Muscle
5. Inflammatory cells
    - Dermal dendrocytes
    - Lymphocytes
    - Fibroblasts

Vasculature:

• Deep vascular plexus – are present at junction of reticular dermis and subcutaneous fat. They are oriented parallel to the surface of the skin.

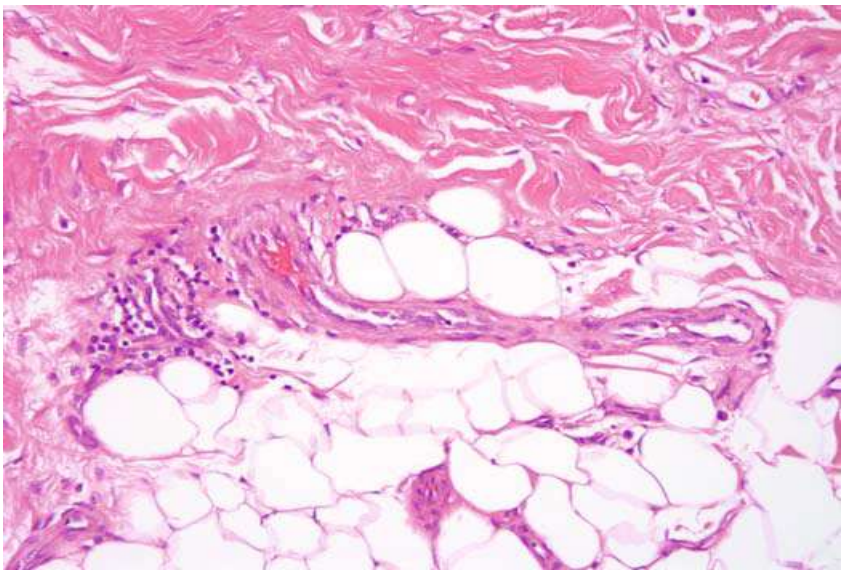


Fig. 6 Deep vascular plexus separates the deep reticular dermis from the underlying subcutaneous fat and is oriented parallel with the surface of the skin

• Feeder vessels – are oriented perpendicular to epidermal surface and connect superficial and deep vascular plexuses.

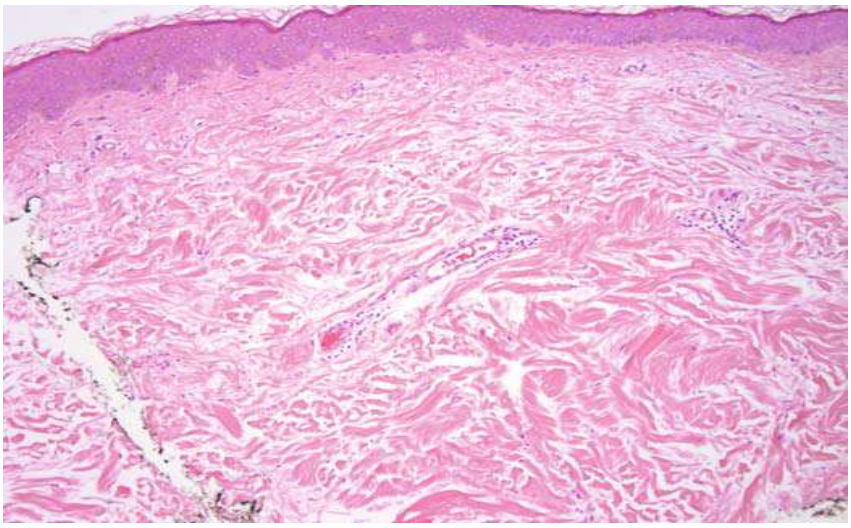


Fig. 7 Feeder vessels course through the dermis perpendicular to the surface of the skin

• Superficial vascular plexus – separates papillary from reticular dermis and are oriented parallel to surface of skin.

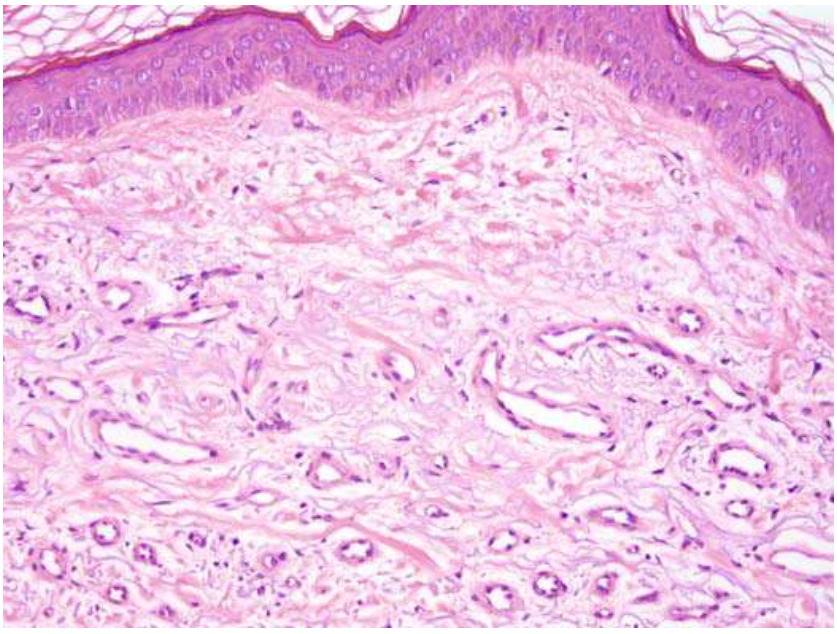


Fig. 8 The superficial vascular plexus separates the papillary from the reticular dermis and courses parallel to the surface of the skin

• Post capillary venules – extend from superficial vascular plexus into dermal papillae.

Collagens:

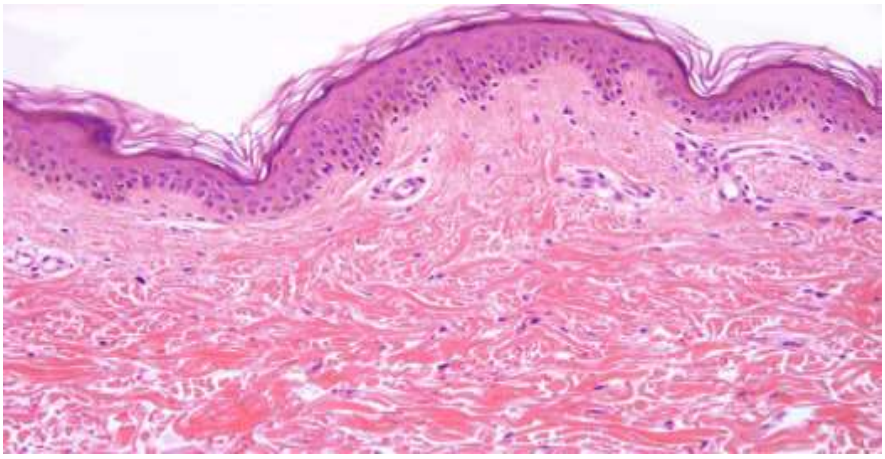


Fig. 9 Large bands of eosinophilic collagen oriented vaguely parallel with the skin surface comprise the reticular dermis

• Type I – main constituent of reticular dermis. Also present in papillary dermis. Made up of big, thick eosinophilic bundles.

• Type II – major component of cartilage.

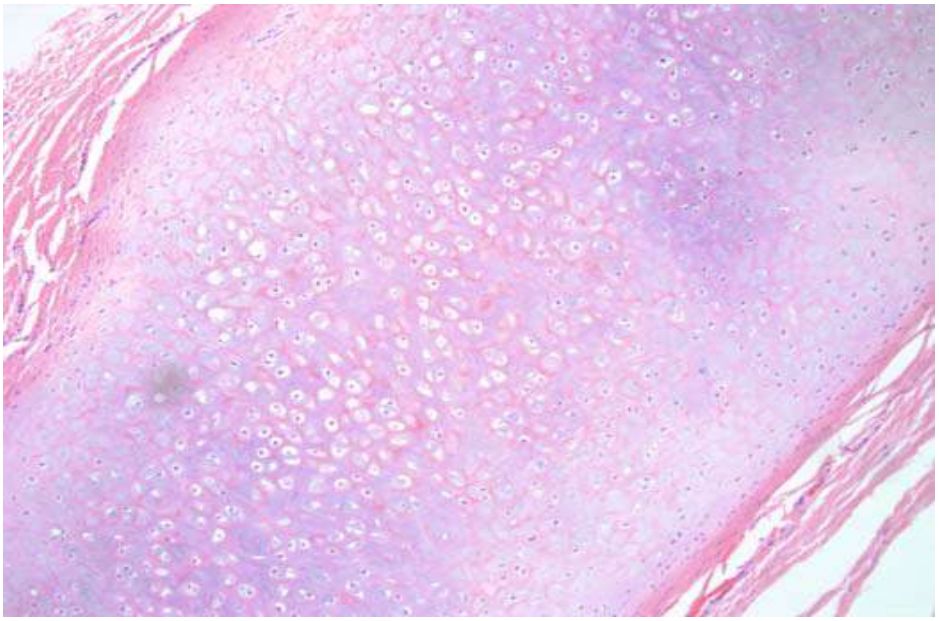


Fig. 10 Type II collagen that is found deep to the dermis in the cartilage in biopsies from the nose and the ear

• Type III – is present in large quantities in papillary dermis and in newly formed scar tissue and fetal dermis. It has smaller bundles and is less eosinophilic than type I collagen.

• Type IV – basement membrane collagen.

• Type V – in fetal membranes and vascular tissue.

• Type VI – in neurofibromas.

• Type VII – anchoring fibrils.

Elastic Tissue:

Consists of the following types of fibres-

• Oxytalin which are thin fibers, perpendicular to DEJ in papillary dermis.

• Elaunin which is network of fibers oriented parallel to DEJ in upper reticular dermis. These give rise to oxytalin fibers and are rich in microfibrils with little elastin.

• Elastic fibers in deep reticular dermis are much larger and connect to elaunin fibers.

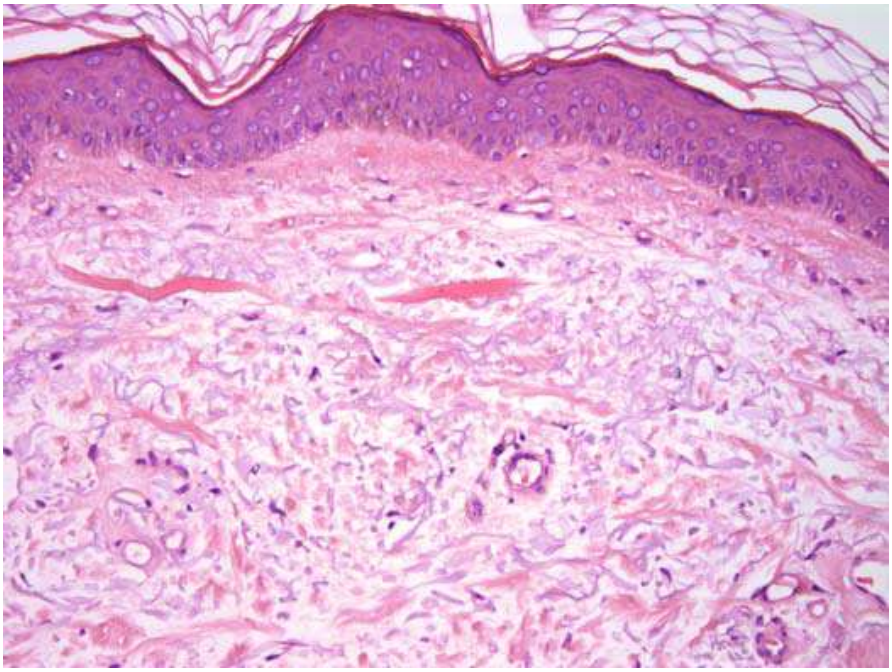


Fig. 11 Elastic tissue fibers

Nerves:

• Mucocutaneous end organs which cannot be recognized on routine sections. Present on lips and genital skin.

• Meissner's corpuscles – present exclusively on ventral surfaces of hands and feet and are seen in about every fourth dermal papilla. These serve as touch receptors.

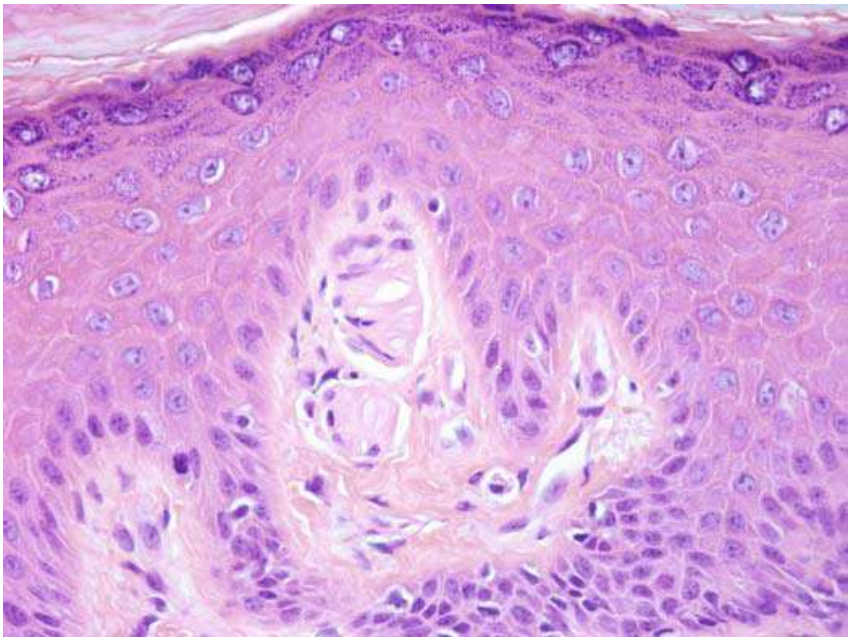


Fig. 12 Meissner's corpuscles are present within approximately every fourth papillary dermal tip

• Pacini-Vater corpuscles – subcutaneous; most common on fingers and toes. These serve as pressure receptors.

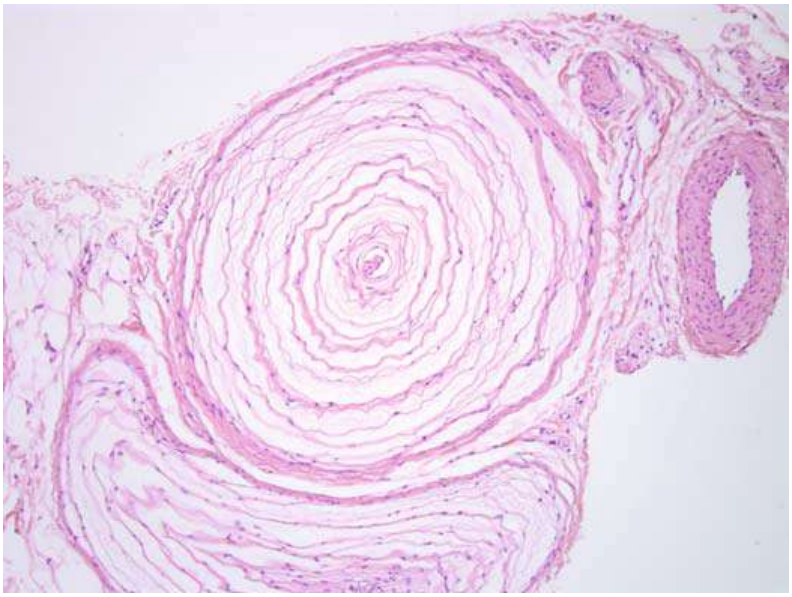


Fig. 13 Pacinian corpuscles are present in the deeper dermis in acral skin

• Autonomic nerves– innervate vessels, smooth muscle, apocrine and eccrine (but not sebaceous) glands

Muscles:

• Arrector pili

– Smooth muscle around vessels and hairs

– Pilar type insert at isthmus of hair follicles

– Autonomically innervated

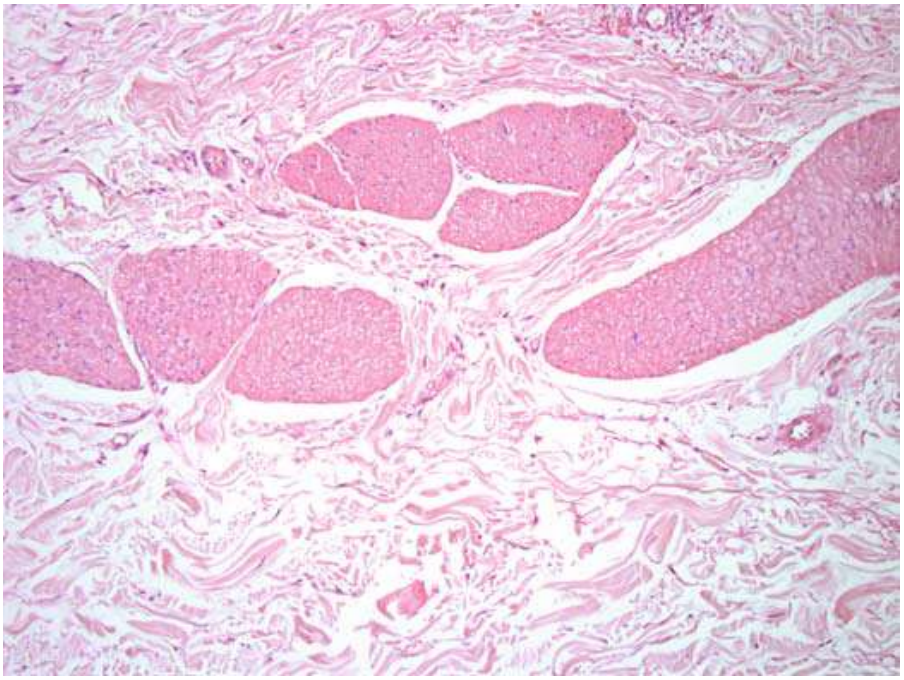


Fig. 14 Arrector pili muscles are located in the mid-reticular dermis and attach to hair follicles

• Glomus cells

– Mainly in nail beds of fingers and toes

– Surround arterioles at Suquet-Hoyer canal

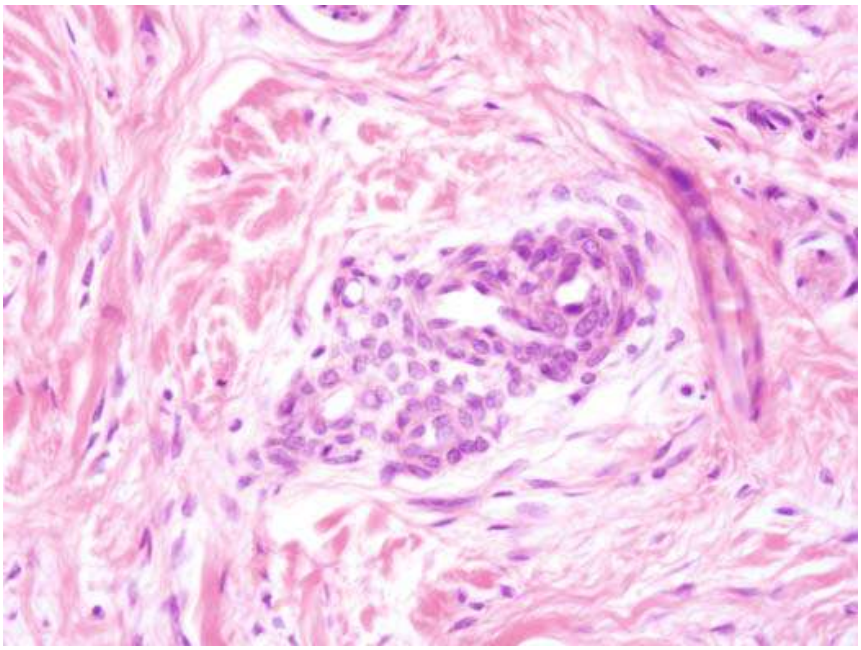


Fig. 15 Glomus cells are prevalent surrounding dermal blood vessels in acral skin

Dermal Dendrocytes:

• Generally accepted to be derived from the bone marrow.

• Reside in dermis

• Involved in antigen presentation

• These are spindle-shaped cells resemble fibroblasts on routine sections

• Express factor XIIIa (transglutaminase from coagulation cascade) which is useful for immunohistochemical identification of these cells

• Increased in many immune responses.

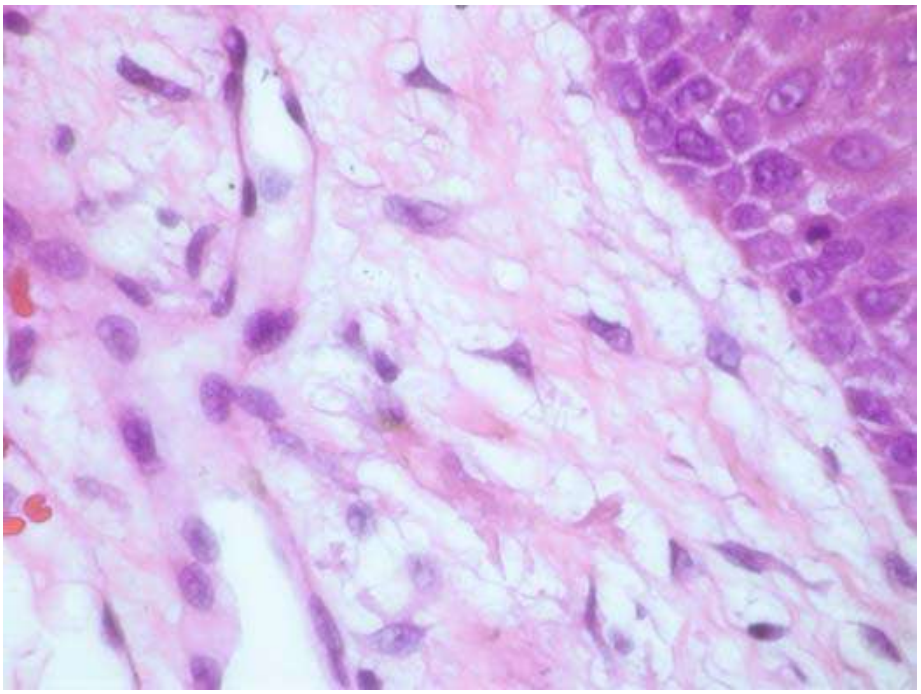


Fig. 16 Spindle-shaped dermal dendrocytes are present within the papillary and reticular dermis

Lymphocytes:

• Normally present in small numbers around vessels of superficial vascular plexus.

• Constituted by 80% T cells, 20% B cells, almost no natural killer cells.

• 3–4 times more CD4+ than CD8+ cells

Mast Cells:

• Normally present around vessels in superficial vascular plexus.

• Can appear spindle shaped and resemble fibroblasts.

• Up to six can be seen normally around each vessel in inflammatory states.

Fibroblasts:

• Present within dermis

• Responsible for producing types I and III collagen normally found in dermis

• Not all dermal spindle cells are fibroblasts (mast cells, dermal dendrocytes, pericytes are all present and may appear spindled)

• Unclear relationship between fibroblasts, histiocytes, and tumors with "fibrohistiocytic" differentiation

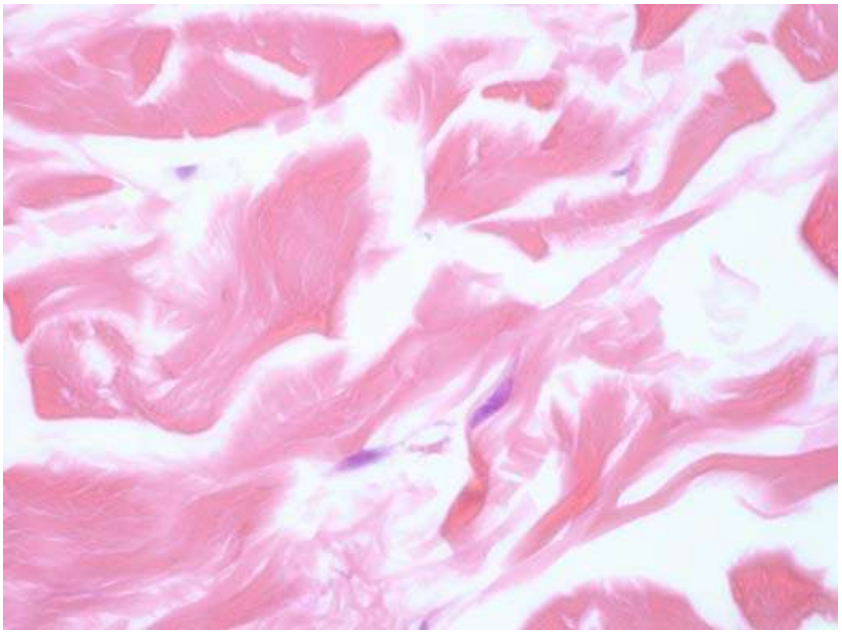


Fig. 17 Fibroblasts appear as spindle-shaped cells in the dermis, interspersed between collagen bundles

FUNCTIONS OF SKIN:

Protection: skin is a barrier from pathogens and damage between the internal and external environment. Langerhans cells in the skin are part of the adaptive immune system.

Sensation: contains a variety of nerve endings that jump to heat and cold, touch, pressure, vibration, and tissue injury.

Heat regulation: by regulation of blood flow to cutaneous vessels heat loss and heat conservation is done by the skin.

Control of evaporation: the skin provides a relatively dry and semi-impermeable barrier to fluid loss.

Storage: acts as a storage organ for lipids and water.

Absorption: Oxygen, nitrogen and carbon dioxide can diffuse into the body through skin in small amounts. Some animals use their skin as their sole respiratory organ.

Water resistance: The skin acts as a water resistant barrier so essential nutrients aren't washed out of the body.

Synthesis: Vitamin D3.

SKIN GRAFTING[8]

Skin grafting procedures originated approximately 2500 to 3000 years ago, when surgeons of the Hindu Tilemaker caste replaced noses amputated as punishment for theft and adultery with skin grafts harvested from the gluteal region[9]. It was not until the nineteenth century, however, that skin grafting was reintroduced. In 1869, Reverdin's account of pinch grafting for leg ulcers was published; in

subsequent decades, Ollier and Thiersch's accounts of thin split-thickness skin grafting, and Wolfe and Krause's accounts of full-thickness skin grafting, appeared in the literature. The nineteenth century surgeons used skin grafts to address only the most difficult problems of surgical management. Skin grafting has since evolved into a reconstructive option that is now commonly used for the surgical repair of skin defects.

Free skin grafts are pieces of skin that have been severed from their blood supply and transferred to another location. They can be divided into four types: full-thickness skin grafts (FTSGs), split thickness skin grafts (STSGs), composite grafts, and free cartilage grafts[10,11]. Full Thickness Skin Grafts are composed of the entire epidermis and the full thickness of dermis, including adnexal structures such as hair follicles and sweat glands. Split Thickness Skin Grafts are composed of the full thickness of the epidermis and partial thickness of dermis. These can be subdivided into thin, medium and thick grafts, depending on the amount of dermis included in the graft. Composite grafts are composed of at least two different tissue types, usually skin and cartilage. Free cartilage grafts consist of cartilage with its overlying perichondrium.

WOUND HEALING AFTER GRAFTING:

Wound healing after skin grafting proceeds through a unique series of events. The first 24-hour period following graft placement is termed the stage of plasmotic imbibition, during which fibrin glue attaches the graft to its recipient bed, allowing it to take up the underlying wound exudates and to become edematous, gaining up to 40% in weight. The graft thereby remains hydrated and obtains a supply of nutrients, which maintains graft vessel patency until revascularization begins. The

fibrin beneath the graft is subsequently replaced by granulation tissue, which attaches the graft permanently to its bed.

With proper apposition of the graft to its bed, revascularization may proceed. Anastomoses begin to form within 48–72 hours of grafting, between the recipient bed and pre-existing vessels in the dermis of the graft, a process known as inosculation. Vascular proliferation occurs next, with sprouting and budding of vessels in the graft and its bed. Even relatively avascular tissue may be grafted, as long as the avascular area is small and surrounded by a rich vascular supply. Through a process known as the bridging phenomenon, vascular connections arising from the recipient bed allow blood flow to occur through pre-existing graft vasculature, so that nutrients reach the part of the graft overlying the avascular area. Full circulation is restored to the graft within 4–7 days. Restoration of the lymphatic circulation parallels restoration of the blood supply over the first week.

Epidermal proliferation occurs between the 4th and 8th day post grafting and persists for several weeks. Degeneration of sebaceous and eccrine glands may occur initially, but subsequent glandular regeneration may allow partial function to be maintained. Graft reinnervation and return of sensory nerve function may begin as early as 2–4 weeks after grafting, although patients do not usually regain full sensation for many months. If extension of the ischemic period occurs, decreased graft survival may result. Hematoma or seroma formation, infection, or mechanical shear forces may disrupt the fragile vascular connections between the graft and its recipient bed. These complications tend to affect FTSGs (which have a greater volume to nourish and revitalize) more than STSGs.

Even after the ischemic period is past, other factors may combine to decrease the vascular supply nourishing the undersurface of the graft[10-12]. The most

important of these factors is cigarette smoking[12], but diabetes mellitus, protein deprivation, and severe trace element or vitamin deficiencies may also increase the risk of graft failure. Certain systemic medications, such as corticosteroids, chemotherapeutic agents, other immunosuppressive drugs and anticoagulants, may interfere with wound healing as well. Other causes of graft failure include: insufficient vascularity due to necrotic debris within the recipient bed, hematoma, seroma, an avascular wound bed, previous radiotherapy, infection, excessive graft tension, mechanical shearing forces, and improper postoperative care[10,11]. The most common infectious agents associated with graft failure include β-hemolytic streptococci, coagulase-positive staphylococci and Pseudomonas species. Pseudomonal infections are particularly common in auricular grafts. For all of these reasons, a thorough preoperative evaluation, meticulous intraoperative technique, and good postoperative care are essential to maximize graft survival.

Split-thickness skin grafts (STSGs) consist of epidermis and a portion of the dermis. These grafts vary in thickness from approximately 0.005 to 0.030 inches (0.13–0.78 mm), and are classified as thin, medium or thick, depending upon the amount of dermis included in the graft.

Indications and Contraindications:

STSGs have less tissue requiring revascularization than FTSGs, and are therefore more likely to survive when placed on almost any recipient bed, including those with a limited vascular supply. As a result, these grafts may be placed over periosteum, perichondrium, peritenon and perineurium. STSGs are also used to cover large defects, particularly those that cannot be covered by a flap or would heal

too slowly by second intention, as well as refractory venous leg ulcers[10,11]. STSGs may be useful for covering surgical defects in sites at high risk for tumor recurrence, since recurrent tumor is usually visible when growing through split-thickness skin. If the tumor has not recurred after 1–2 years, the graft can be removed and a definitive reconstruction performed.

Advantages of STSGs over FTSGs include their improved chance of survival under conditions of vascular compromise, their ease of application, their ability to cover large defects, and their ability to allow detection of recurrence of high-risk lesions. The principal disadvantages of STSGs include their suboptimal cosmetic appearance, the presence of a granulating donor site wound requiring postoperative care, greater graft contraction, and the special equipment required to harvest larger grafts. Furthermore, because of their relative thinness, STSGs may be less durable than FTSGs, necessitating regrafting or partial healing by second intention. While thicker STSGs tend to be cosmetically superior to thinner ones, poor color and texture match with the surrounding skin often occurs after STSG placement. STSGs tend to be pale or white in color, hairless, and smooth in texture, with impaired sweating due to the fact that adnexal structures are not removed in their entirety with the graft and do not survive. The contrast between the STSG and its surrounding skin can therefore produce a patch like appearance, which is more pronounced than seen with FTSGs.

Preoperative History and Donor Site Considerations:

Cosmesis of the donor site scar should be taken into consideration when selecting a split-thickness donor site. The ease of postoperative donor site care

and the type of instrument used to harvest the graft may also help to dictate donor site choice. Ideally, STSGs should be harvested from a site where a broad area of skin can be removed while still being concealed beneath clothing. The most common donor sites include the anterior, medial and lateral portions of the upper thigh, the inner and outer aspects of the upper arm, and the inner aspect of the forearm. Lower back and abdominal skin can also be harvested. The anteromedial thigh is most frequently used as the donor site for STSGs, as harvesting and wound care are convenient, and wounds in this location do not interfere with ambulation. Donor site wounds on the buttocks tend to require assisted postoperative care, although their scars are ideally placed from a cosmetic standpoint. Power-driven dermatomes and large freehand knives require large flat donor surfaces, which may limit donor sites to the thighs, abdomen and buttocks, while smaller grafts can be harvested freehand or with a power-driven dermatome.

Description of Grafting Techniques:

A wide variety of techniques for harvesting and placing STSGs have been described[10,11,13]. The instruments used to harvest STSGs can be classified into freehand and electric dermatomes. Freehand dermatomes include scalpel blades, double-edged razor blades, and knives such as the Weck blade. Although acceptable grafts can be obtained using these freehand devices, considerable technical expertise is required to harvest them. A standard #15, #15c or #10 blade can be an effective tool for harvesting small STSGs of medium thickness. After a template of the defect is made, the donor site is marked, anesthetized, and scored lightly with the blade. The graft is then harvested by orienting the blade parallel to the skin and gently sweeping

it just below the level of the epidermis, so that the blade is visible beneath the skin. It is helpful to have an assistant apply traction to the donor site while the graft is harvested. Several blades may be required for harvesting, as blade sharpness diminishes quickly with multiple passes. This technique may be especially useful in harvesting small medium-thickness STSGs to repair auricular and postauricular defects.

Power-driven dermatomes became the standard method of harvesting larger STSGs after Brown developed the first such instrument in the 1940s. Electric dermatomes designed to harvest STSGs of varying thicknesses and widths, from several centimeters up to nearly 15 cm, are now commonly employed, and lithium ion battery-powered units are also available. Although STSGs can be obtained easily and reliably with any of these devices when properly used, the quality of the graft is technique-dependent, and substantial irregularity in graft thickness and width may at times occur. The Zimmer dermatome, which was originally powered by compressed water-pumped nitrogen and subsequently modified into an electrically powered version, tends to harvest uniform grafts of predetermined width and thickness such that consistent graft quality tends to be less dependent on the operator's technique. Multipurpose motor systems now exist which include a control box, foot switch and autoclavable motor that can be used not only with dermatomes, but also with diamond fraises for dermabrasion, adjustable skin graft meshers, and other types of surgical handpieces, allowing a wide array of procedures to be performed using a single unit.

After the dermatome is prepared, the donor and recipient sites are anesthetized, prepped and draped in the usual sterile fashion. If chlorhexidine surgical scrub is used, a saline wash is employed to remove any excess scrub. The donor site is

lubricated in advance with sterile mineral oil or another lubricant to ease travel of the dermatome over the skin. The handpiece is held on the donor site at an angle of 30–45°. A throttle control is pressed to start the cut, and the unit is guided forward using light downward pressure to ensure that the cutting edge remains in continuous contact with the donor site. An assistant applies tension by pulling the skin away from the donor area to create a flat, even surface. As the dermatome glides over the donor skin, the graft emerges from the pocket area of the dermatome, and is lifted away from the machine with tissue forceps or hemostats. Once a sufficiently large graft has been harvested, the dermatome is pulled away from the skin and the graft is placed in sterile saline or on sterile saline-soaked gauze. STSGs should be secured so that infection, hematoma or seroma formation, and mechanical shearing forces can be prevented. Both the perimeter and the central portion of the graft must be secured for adequate nutritional support and to ensure graft survival. The edges of STSGs need not be as closely approximated to the surrounding wound edge as those of FTSGs, since overlapping skin will slough without affecting the ultimate cosmetic result. After the graft has been placed such that the dermal side is adherent to the recipient bed, the perimeter of the graft may be secured with sutures or staples. Centrally placed basting sutures may also be helpful in ensuring good apposition of the graft to its bed. Once the graft has been secured and its bolster sewn into place, a non-adhesive dressing or pressure dressing may be applied as an additional precaution. Sutures or staples are removed after 7–10 days.

Meshing the graft with scalpel slits may be performed to allow drainage of accumulated blood or serosanguineous material that could otherwise inhibit graft–bed contact. This technique may also be used to expand the surface area of STSGs. A graft meshing machine may be utilized to expand the surface area of the

graft further by ratios ranging from 3: 1 to 9: 1. Meshing can help to provide coverage of a large recipient area with smaller donor grafts. Expanded meshed grafts placed experimentally on contaminated recipient beds have been found to exhibit increased take up as compared with non-meshed donor skin.

Complications:

The complications of split-thickness skin grafting can be divided into early complications, which result from failure of graft uptake, and late complications[10,11]. Failure of graft uptake may result from hematoma or seroma formation, infection, or shearing forces. Late complications can be divided into cosmetic and functional problems. Colour and texture mismatch of STSGs with the surrounding skin is predictable and expected. Grafts often remain erythematous for months to years after placement. More importantly, they may exhibit significant postoperative hyperpigmentation or hypopigmentation. Darker-skinned patients are especially prone to graft hyperpigmentation, despite observance of preventive measures. Patients should minimize graft exposure to the sun without sunscreens for 6 months, and wear sunscreens consistently thereafter. The absence of adnexal structures can predispose to xerosis and a buildup of keratinous debris. The resultant scaling, pruritus and dryness can be minimized with liberal use of emollients.

Functional considerations are of paramount concern, since STSGs contract more than FTSGs and can create forces powerful enough to produce joint contraction if placed over or near joints. Contraction of facial grafts, especially near the nasal ala, the eyelid, the helical rim and the free margins of the vermilion border, may produce significant cosmetic deformities, including alar retraction, ectropion, helical rim distortion and vermilion border distortion. Hypertrophic scarring of the graft and donor sites may also occur, and can be treated with corticosteroid-

impregnated tape, intralesional corticosteroids, or pulsed dye laser. Graft fragility and breakdown can occur in areas of trauma, particularly in sites such as the lower leg, or in areas with little underlying soft tissue support, such as those directly overlying perichondrium or periosteum. These complications are not always avoidable, but forewarning patients may reduce unnecessary trauma to the area. Lastly, bullae can occur within graft sites, presumably related to decreased anchoring properties of the basement membrane zone.

The first accounts of skin grafting described in literature were of Sushruta 'The father of Plastic Surgery' in 1000 -800B.C[14]. The origins of the technique were related to the deep seated practices in ancient India where nose was considered as the symbol of morality and mutilations were common. His description of nasal reconstruction can be traced throughout the literature till the modern day surgical practices. Although the classical description of Sushruta is reconstruction of the nose by a pedicled cheek flap he also described the repair of a cut earlobe, piercing of an earlobe, repair of a lacerated lip, skin grafting, classification of burns, wound care, and wound healing[15].

Split thickness skin grafts (STSGs) consist of epidermis and a portion of the dermis. These grafts vary in thickness, and are classified as thin (0.005 to 0.012 inches), medium (0.012 to 0.018 inches), or thick (0.018 to 0.030 inches), depending on the amount of dermis included. STSGs have less tissue requiring revascularization than FTSGs, and are therefore likely to survive on almost any recipient bed, including those with a limited vascular supply. STSGs are used to repair large defects, including those that cannot be covered by a flap or would heal too slowly by secondary intention.

In modern day surgical practice skin grafting is a commonly used reconstructive procedure. Inspite of the widespread use of grafting by surgeons, there is no fixed protocol in the management of donor site and is subject to surgeon's preference. Traditionally paraffin gauze dressings were used which reduce irritation and provide a moist environment that promotes healing. With the advent of new materials for dressing the never ending search for the best dressing material is still going on. Some of the materials used being alginate, hydrocolloid, methacrylate, synthetic collagen sheets, silver containing dressings apart from others.

Silver is a naturally occurring element that has been used for millennia for currency and jewelry; for food serving; for water purification; and, more recently, for electrical and industrial applications. Ionized silver (Ag+1) has known antimicrobial properties and has been employed in burn wound care for over 200 years. More recently, the health-promoting properties of silver have been emphasised in a number of consumer products, including silver-containing clothing, refrigerators, and washing machines that claim to deodorize or sanitize by killing germs[16]. Several new wound dressings and gels containing silver ion or silver compounds are currently available. The rediscovery of silver for medicinal uses has prompted extensive discussion by supporters and condemners of silver use in medicine.

Prior to the establishment of the Germ Theory of disease, the use of silver for medicinal purposes was based on folklore or tradition. Probably the earliest medical use of silver was for water disinfection and storage[17]. Alexander the Great (335 BC) stored and drank water in silver vessels when going on campaigns[17-20]. The Greeks and Romans also stored water in silver vessels to keep it fresh. Ancient Mediterranean and Asiatic cultures used silver flasks and storage containers to prevent spoilage of liquids, and placed silver foil into wounds to prevent infection[21].

The Romans included silver in their official book of medicines and were known to have used silver nitrate[18]. Ambrose Pare, a pioneer of battlefield surgery and served as royal surgeon to Kings Henry II, Francis II, Charles IX and Henry III, has championed the use of silver clips for facial reconstruction[22]. The Germ Theory of disease postulated that microorganisms were responsible for certain diseases. Evidence to support this theory came from Semmelweis in 1847 (hand washing), John Snow in 1854 (epidemiology of a cholera outbreak), Davaine in 1865 (identification of anthrax bacteria in blood), Louis Pasteur in 1880 (isolation and culture of chicken cholera bacteria), Robert Koch in 1876 (isolation of Bacillus anthracis and Koch's Postulates; and others[23]. The idea that microbes could cause disease and the fact that silver ion had strong antimicrobial properties provided a rational basis for the medicinal uses of silver that were already in place.

William Halstead, MD became the first Chief of Surgery at the Johns Hopkins Hospital in 1889. In this capacity, he established the first surgical residency program in the United States. Halstead advanced the field of wound healing, and was an advocate of careful hemostasis, aseptic technique, meticulous anatomic dissection and tension-free closure. Among his other surgical innovations, Halstead employed silver wire suture for hernia repair and found silver foil an effective means of controlling postoperative wound infections[22,24]. Silver in its numerous forms has been used for over 200 years in the treatment of burn injury[25,26] and silver nitrate solutions in 5% and 10% concentrations were used as caustics or escharotics in the early 20th century[27]. The use of silver increased during the 1960s for burn wounds care.

The last two decades of the 20th century saw the development of silver-based textiles for burn and wound dressings. A number of centers investigated

the antimicrobial properties of silver-coated nylon, a fabric which was originally developed as a flexible electrical shield or radar reflector[28,29]. Deitch et al. examined the antimicrobial properties of silver nylon in vitro and showed effectiveness against P. aeruginosa, S. aureus and Candida albicans[28]. Spadaro et al. demonstrated that weak electric current delivered thru silver electrodes was bacteriostatic against agar plate bacterial cultures of S. aureus, Escherichia coli, Proteus vulgaris and P. Aeruginosa[30]. The US Army Institute of Surgical Research (US Army Burn Center) extensively researched the combined effects of silver-nylon fabric and weak electric (direct) current on wound healing and published at least 13 studies between 1988 and 2005[29,31-42]. A variety of animal models of partial and full-thickness burns, infected burn wounds, excised burn wounds, donor sites, and skin flaps evaluated the utility of silver-nylon with and without direct current on wound healing, microcirculation, wound edema, plasma protein extravasation, and wound closure using split thickness skin grafts, autograft/allograft composite grafts, and dermal replacement/meshed autograft techniques[29,31-42]. Two human trials were carried out, including one study of donor site healing[42]. Independently, Huckfeld et al. demonstrated that weak direct current applied to silver-nylon dressings could accelerate wound closure after split thickness skin grafting in humans[43].

One of the most significant statements focussing on silver dressings has been made by Mooney et al[44]. Their opinion can be summarised as follows:

• Broad spectrum antimicrobial efficacy of topical silver-impregnated dressings is not in dispute.

• Choice of dressing rests on

– characteristics of the carrier dressing;

– delivery kinetics of silver to the wound;

– the needs of the wound at any given time.

Viewing all silver dressings like mere carriers of silver does not suffice. It is therefore necessary to look beyond the mere delivery of the topical agent and its antimicrobial impact and examine the contribution that the carrier dressing has to make to the progress of the wound. That is, the effects of dressing on the factors that inhibit healing.

HOW THE DRESSING TECHNOLOGY CAN ASSIST IN MANAGING PAIN[45]

Pain is a known impediment to healing process that produces physiological stress. The changing of a wound dressing is recognised as a time when pain is most likely to occur. Preventing wound trauma and pain were identified as the two main considerations at dressing change highlighted via a survey of nearly 4000 clinicians using a multiple choice questionnaire[46]. It is therefore important to use tactics that avoid/minimise trauma to the wound/peri-wound skin and the occurrence of what Krasner[47] has called cyclic acute wound pain. Wound dressing technology has improved so much and can be focused on reducing pain. The three most important factors identified by Moffatt et al. [46] are dried out dressings, products that adhere and adhesive dressings. Pain occurring at dressing change, the operational pain, has received increasing attention in recent years. Two influential publications have focussed on pain associated with dressing related procedures: the World Union of Wound Healing Societies' Principles of best practice[48] and European Wound Management Association's Position document[49]. These publications propose broad strategies to assist in minimising pain at dressing change. A third publication by Thomas[50] proposed that the term 'atraumatic dressing' could be used to describe those products that are proven to avoid causing trauma to the wound bed or peri-wound skin

on removal, and included a review of the literature focussing on soft silicone dressings. Soft silicone dressings with topical antimicrobial coatings have come into picture recently as the focus shifted towards atraumatic dressing.

In a randomised study comparing a silver polyethylene mesh dressing with 0.5% silver nitrate solution, Tredget et al.[51] found that on dressing removal, patients reported pain was lower with the silver polyethylene mesh than on removal of the silver nitrate solution. However, patients also reported that the pain was comparable during application and 2 hours following application of either dressing. Therefore, in the short term there appears to be little merit in using this dressing approach.

In an open, prospective, randomised, controlled, multicentre study, a total of 131 leg ulcer patients were recruited and randomised to hydrofibre or to alginate dressing groups[52]. Ease of application was rated 'excellent' by 76% in the hydrofibre group compared with 55% in the alginate group (P = 0.03). More importantly, ease of removal was rated as excellent by 51% of the hydrofibre group compared with 24% of the alginate group (P = 0.006).No pain at dressing removal was experienced by 82% of the hydrofibre group compared with 62% in the alginate group ($P < 0.001$). Less adhesion ($P < 0.001$) and less residue ($P < 0.001$) were also reported in the hydrofibre group thus minimising trauma to the wound bed. Moffatt et al. [46] stated that products such as hydrofibres, alginates amongst others are least likely to cause pain. In the above study it can be seen that hydrofibre outperformed alginate according to the identified parameters.

In a randomised acute/surgical wound study in 100 patients, hydrofibre performance was compared with that of alginate[53]. Ninety-two per cent of patients randomised to the hydrofibre dressing were found to experience less pain

(mild or none) compared with those who received alginate dressings 80%. Similarly, those patients who were pain free at week one postoperatively were hydrofibre 84% compared with alginate 58%. Although statistical significance was not shown, the researchers concluded that the hydrofibre dressing consistently performed better than the alginate.

A multicentre prospective randomised controlled trial (RCT)[54] reported on the use of a carboxymethylcellulose dressing containing ionic silver (AgNaCMC) and 1% silver sulphadiazine (SSD) cream impregnated gauze in the management of partial-thickness burns (n = 84). The authors reported less pain during dressing change and less burning/stinging during wear time (up to 21 days) with the AgNaCMC together with a decreased demand for procedural and narcotic analgesia.

Fifty patients with partial-thickness burns were randomised into two equal groups who received either 1% SSD or a silver-coated, high-density polyethylene mesh dressing (Ag polyethylene mesh)[55]. Treatments consisted of either dry gauze dressing with 1% SSD changed twice daily or dry gauze moistened with sterile water and application of an Ag polyethylene mesh with the gauze being moistened twice daily and the outer Ag polyethylene mesh changed every 3 days. The conclusions drawn by the authors of this study were that the Ag polyethylene mesh provided a less painful alternative to wound care than 1% SSD because of longer wear time and ease of application/removal (average pain scores being 4 ± 0.6 for an Ag polyethylene mesh versus 5 ± 0.7 for 1% SSD).

In an open label, multicentre, non comparative study on 18 patients with chronic leg ulcers where the primary aim was to assess safety of an AgNaCMC dressing, Vanscheidt et al.[56] found that a significant reduction in the pain scores recorded by the patients was achieved. It needs to be borne in mind that 11 of the 18

subjects' wounds were infected at baseline. At each dressing change the patient was asked if the dressing had been comfortable since the last visit. All 129 responses were either very comfortable (13.18%) or comfortable (86.82%). For pain on dressing removal, no pain was recorded at 45.7% of dressing changes with low levels of pain being recorded on 33.3% occasions.

Jester et al.[57] recognises the fact that dressings differ in material characteristics and evaluated dressing performance and pain during dressing change of two silver dressings: a soft polyester with lipido-colloid coating impregnated with SSD (polyester LC SSD) and a non adhesive polyurethane foam dressing impregnated with silver (polyurethane foam Ag). This retrospective cohort study included two groups of 20 burns treated with polyester LC SSD and polyurethane foam Ag until the wounds healed or were grafted. There were 67 dressing changes in the polyester LC SSD group and 70 in the polyurethane foam Ag group. Both dressings were found to perform well when considering pain at dressing change and ease at dressing application. The polyurethane foam Ag dressing was found to have a greater absorptive capacity than the polyester LC SSD dressing.

In a prospective, randomised study, Glat et al.[58] assessed the clinical and microbiological characteristics of two silver-based topical agents in the management of paediatric partial thickness burns. Twenty-four patients ranging in age from 2 months to 18 years with total body surface area (TBSA) burns ranging from 1% up to 40% were enrolled and completed the study. Patients were randomised to either a silver-containing gel or to a SSD cream for up to 21 days or to the point of full reepithelialisation of the wound. No statistically significant differences were found when assessing the rate of infection, time to reepithelialisation, or the number of dressings changes required during treatment. A reduction of pain and improved

patient satisfaction with the use of the gel indicates an important role for it in the treatment of partial-thickness burns.

THE VALUE OF CLOSE ASSOCIATION OF DRESSING WITH THE WOUND BED[45]

Snyder[59] has recorded that the presence of dead space may act as a nidus for infection and contribute to delayed healing. Robson et al. (1973) cited by Edberg[60] states that dead space lends itself to infection because it does not possess a defence mechanism. These statements clearly indicate that there is a need to avoid the creation of dead space (void within a viscus or between dressing and wound bed) as there is an apparent association of dead space with risk of infection. In order to circumvent this situation when applying a wound dressing, the clinician should ensure that the dressing has the capacity to maintain a close association with the wound bed. A close association of the dressing with the wound bed will help promote absorption of exudates if the dressings are absorptive type and the delivery of silver to the wound bed in silver containing dressings.

Vanscheidt et al.[56] made an empirical observation in their study on 18 patients with chronic leg ulcers that the gel matrix formed by the AgNaCMC dressing moulded itself over the wound surface and eliminated dead space. This observation was subsequently confirmed by Jones et al.[61] who investigated the conformability in vitro of two silver dressings to human wound tissue, dried dermal membrane and indented agar plates that had been seeded with MRSA or Pseudomonas aeruginosa. The results showed that there was excellent conformability of the AgNaCMC dressing to the dermal tissue (wound bed) but this was less evident with Ag polyethylene mesh dressing. Incidentally, the AgNaCMC dressing in this

study was more effective at killing bacteria on the indented agar plates than the Ag polyethylene mesh dressing.

The intimate association of a dressing with the irregular undulating topography of the wound bed would appear to offer advantages when considering the avoidance of the creation of dead space, absorption of exudate and bactericidal activity of ionic silver.

FLUID-HANDLING PROPERTIES ABSORPTION/RETENTION, LATERAL WICKING, SEQUESTRATION[45]

Before the advent of products that incorporated antimicrobials, dressings were used principally from the perspective of material performance in situ. Up until the 1960s, dressings comprised mainly of woven textiles with a primarily covering/protective function and were not regarded as agents capable of enhancing healing. Following the work of Winter[62], dressing design took into account the contribution that the dressing material could make to the reparative process. However, traditional dressing materials such as gauze continue to be used despite recognition that it does not comply with optimal management requirements. Modern wound dressings keep a moist wound environment while at the same time providing an absorptive capacity. If problems associated with excess moisture at the dressing interface are not managed correctly, then optimal healing will be compromised. Where absorption of exudate is required, the dressing should also be capable of retaining the fluid ensuring at the same time that the peri-wound skin is not subjected to maceration.

Parsons et al.[63] in an in vitro study investigated the clinical performance of seven proprietary silver-containing dressings including fluid-handling properties and dressing pH. The findings show that the best fluid retention under

compression was achieved by AgNaCMC and a silver-containing alginate dressing (Ag alginate) with the lowest level of lateral wicking occurring with the AgNaCMC dressing. This paper also states, 'This study suggests that dressing selection should be based on the overall properties of the dressing clinically relevant to the wound type and condition'.

SEQUESTRATION[45]

In addition to the ancillary attributes listed above, it has been claimed that the capacity of a dressing to absorb and retain (i.e. sequester) bacteria is an important function, particularly in chronic wounds. In vitro and animal in vivo microbiological studies have illustrated the extent of this effect in hydrofibre and alginate dressings[64-67]. Whilst the clinical significance of this feature is yet to be shown, it is likely to be of value in reducing bioburden in colonised wounds where antimicrobials are not indicated, that is routine use in chronic wounds. This would not contribute to selection for resistance as the function is purely physical. A similar function has been described for the binding of bacterial toxins. In this context, a silver dressing containing activated charcoal has been shown to adsorb endotoxins from Escherichia coli and P. aeruginosa in a standard assay. Although this too has yet to be shown clinically, it is an important mechanism for neutralising an important virulence determinant. The physical principle of hydrophobic interaction has been utilised to sequester bacteria through the addition of a hydrophobic coating containing a fatty acid derivative (dialkylcarbamoyl chloride) to the dressing fibres. Bacteria and other micro-organisms are 'bound' to the dressing when in contact with a moist environment. The micro-organisms are then removed when the dressing is changed. In a 116 patient multicentre study with a mean treatment period of 37 days, 81% of wounds showing signs of infection at the start of the treatment healed. Twenty-one

per cent of patients' wounds healed with a further 72% showing improvement in wound healing[67].

Hydrophobic interaction would appear to offer a 'natural' approach to wound healing. There are no chemically active agents and no known side effects or risk of bacterial/fungal resistance.

CONTROLLED SUSTAINED RELEASE[45]

It is generally recognised that for any antimicrobial to be effective, it is important that the target organisms be exposed to a cidal concentration for sufficient time – without tissue toxicity. This applies to silver-containing wound dressings, the characteristics of the 'ideal' silver-containing dressing having been published[68]. The antibacterial activity of silver emanates from the ionic form Ag+; this has been studied extensively in vitro and reviewed[69]. The sustained exposure (over 24 hours or more) to very low levels (ppm) of silver will be effective against a wide range of bacterial species including those with known antibiotic resistance, for example MRSA and Vancomycin resistant enterococci (VRE)[50,61,69-71].

It is pertinent to emphasise at this point the fact that publications reporting on aqueous silver concentrations do not differentiate between active ionic silver (Ag+) and inactive silver in solution (Ag0); they only measure total silver content. Parsons et al.'s[63] in vitro findings also clearly inform us that the antimicrobial activity of *any* dressing is not necessarily dependant on the amount of silver released as 'there appears to be no correlation between total silver in solution and antimicrobial efficacy'. This accentuates our earlier statement that the ancillary function of dressings containing silver should be taken into account and draws attention to the physical components of dressings and the role they have to play in promoting healing. Silver has been used prophylactically to prevent infections and

silver-coated metallic dressings have been found in vitro to be effective against fungi, bacteria and multiresistant bacteria.

Atiyeh et al.[72] confirm that this form of silver dressing may be useful in preventing infection and also indicate that silver-coated metallic dressings provide a high concentration of silver (around 70 ppm) in the wound by releasing Ag+ and Ag0. What is not clear is the proportion of Ag+ and Ag0 present in the wound and the value of such a high concentration if silver is accepted as being bactericidal/bacteriostatic at oligodynamic concentrations. Although Ag0 (metallic silver) may oxidise to Ag+ in contact with the atmosphere, there is no evidence that it is antimicrobial in action. However, Atiyeh et al.[72] do suggest that the dissolution of silver may favour antimicrobial and anti-inflammatory activity.

MODULATION OF INFLAMMATION[45]

Inflammation is an early and vital stage of the reparative process and is mediated by a number of cells. Although inflammation is a necessary process, excessive or prolonged inflammation results in delayed healing and increased scarring. In a study using a rat wound model, Hoekstra et al.[73] made a histological comparison of acute inflammatory responses in partial-thickness wounds when using a hydrofibre or tulle gauze dressing. The findings show that there was minimal inflammation in the hydrofibre dressed wounds when compared with the Tulle gauze dressed wounds. This difference was attributed to the formation of a thin fibrin polymerised layer between the hydrofibre dressing and the wound bed. This layer of fibrin clearly separated the Polymorphonucleocytes within the hydrofibre dressing from the macrophages that invaded the wound bed 3–4 days after wounding. Less macrophages were evident in the wound bed and none were detected in the dressing. Macrophages separated from granulocytes act in the repair mode and are not activated

for defence purposes. This phenomenon of reduction of inflammation is termed 'quiet inflammation'. In the wounds dressed with Tulle gauze, material was found embedded in the wound bed which showed 'a disturbed pattern of epithelial outgrowth' and 'damage to the dermal matrix'.

In a study by Blome-eberwein et. al.[74], seventy subjects were treated with two protocols of silver dressings (36 adherent, 34 gelled) and the following results obtained. By study day 14, 77% of donor sites had healed (67% adherent, 88% gelled). Pain scores decreased over time in both treatment groups. Investigators were ''very satisfied'' or ''satisfied'' with (adherent, gelled) time required to manage dressing change (89%, 79% of subjects), minimization of donor-site pain (64%, 82%), ease of application (97%, 94%), management of drainage (92%, 82%), ease of removal (77%, 85%), and ability of dressing to remain in place (69%, 76%). Thirty-nine (56%) subjects had adverse events, most commonly non-donor-site infection (11%) and gastrointestinal events (11%).

Skin and mucous membrane discoloration and argyria like symptoms though are common with oral ingestion of silver, only few studies have reported these complications in the skin following local application. Lansdown and Williams in their report of how safe is silver in medicine[75] mentioned few cases of argyria have been reported in patients treated with silver dressings, but clinical observations in London's Charing Cross Hospital have identified grey-black deposits in wound debris following application of Acticoat to heavily exuding wounds. Similar observations were reported in clinical trials with Contreet dressings, and these were removed by gentle washing[76]. The chemical constitution and toxic implications of the precipitates are unknown.

MATERIAL AND METHODS

SOURCE OF DATA:

Patients who underwent split thickness skin grafting fulfilling the inclusion and exclusion criteria in department of surgery at R.L. JALAPPA HOSPITAL, TAMAKA, KOLAR. The duration of study was one and half years.

METHOD OF COLLECTION OF DATA:

Inclusion criteria:

- Patients undergoing split skin grafting at R L Jalappa Hospital.

Exclusion criteria:

- Patients who are immunocompromised
- Patients on long term steroid therapy
- Patients with donor sites other than thigh
- Patients less than 18years age

SAMPLE SIZE

- **Group 1- 30**
- **Group 2- 30**

Sampling Procedure:

Patients fulfilling the inclusion and exclusion criteria were included in this study. All the patients underwent routine investigations before surgery. Written and informed consent was taken from all patients for participating in the study. Split thickness skin grafting was done by experienced surgeon under anaesthesia.

Patients were randomised into 2 groups using block randomisation. In Group 1 patients, donor sites were dressed with paraffin gauze dressings and in Group 2 patients, donor sites were dressed with silver impregnated dressings.

Post operatively the patients were assessed for pain using visual analogue scale on days 5 and 10. The dressing was opened on the 14th day to see for epithelisation of donor site. The epithelisation is assessed by clinical experience.

Pain was assessed by visual analogue scale.

Visual analogue scale:

- 0 No pain
- 1-3 Mild pain
- 4-6 Moderate pain
- 7-10 Severe pain

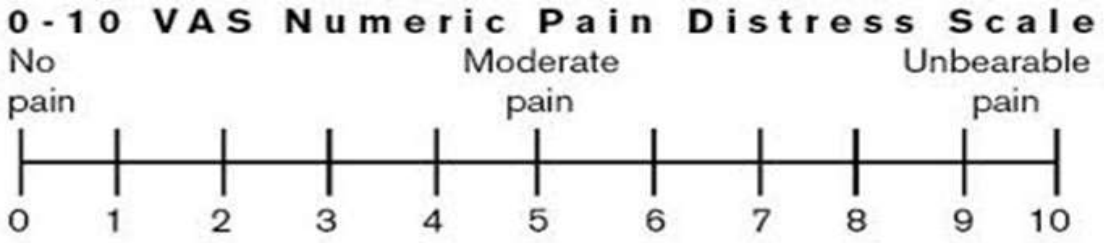


Fig. 18 Visual analogue scale

Epithelisation grading according to the wound surface area considered in the study is

- Grade 1 – <25%
- Grade 2 – 25- 50%
- Grade 3 – 50- 75%
- Grade 4 – >75%

Statistical analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. **Chi-square test** was used as test of significance for qualitative data. Continuous data was represented as mean and SD. **Independent t test or Mann Whitney U test** was used as test of significance to identify the mean difference between two quantitative variables and qualitative variables respectively.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram and Pie diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

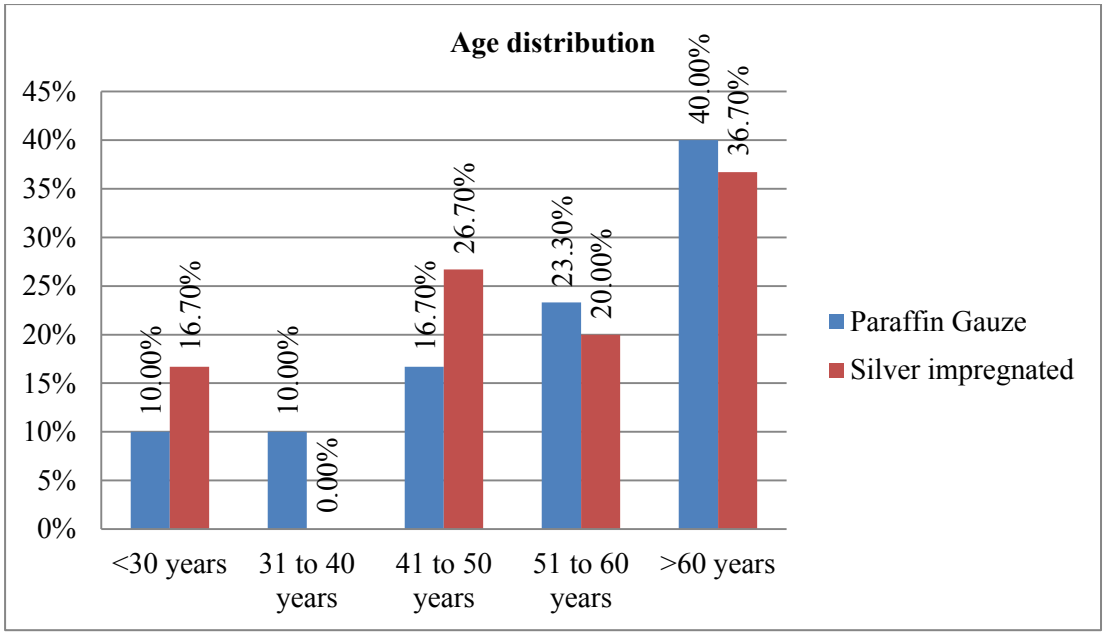
RESULTS

Table 1: Age distribution of subjects in both the groups

		Group			
		Paraffin Gauze		Silver impregnated	
		Count	%	Count	%
Age	<30 years	3	10.0%	5	16.7%
	31 to 40 years	3	10.0%	0	0.0%
	41 to 50 years	5	16.7%	8	26.7%
	51 to 60 years	7	23.3%	6	20.0%
	>60 years	12	40.0%	11	36.7%

χ 2 = 4.313, df = 4, p = 0.365

In Paraffin Gauze group majority were in the age group >60 years (40%) and in Silver impregnated group majority were in the age group >60 years (36.7%). There was no significant difference in age distribution between two groups.

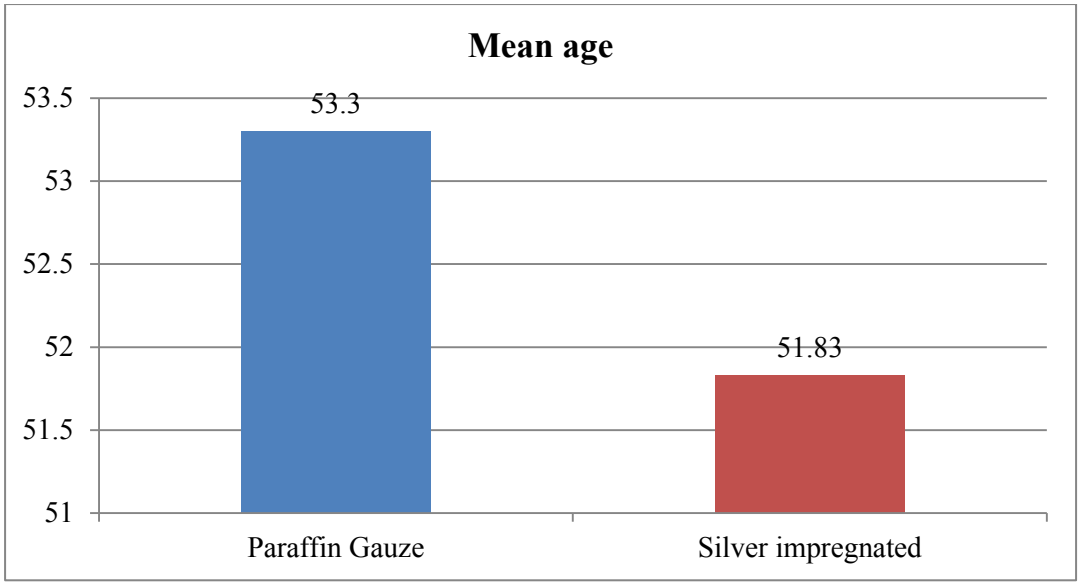


Graph 1: Bar diagram showing Age distribution of subjects in both the groups

Table 2: Mean age of subjects in both the groups

	Group	N	Mean	SD	P value
Age	Paraffin Gauze	30	53.30	13.512	0.676
	Silver impregnated	30	51.83	13.550	

Mean age of subjects in Paraffin Gauze group was 53.3 ± 13.5 years and in Silver impregnated group was 51.83 ± 13.5 years. There was no significant difference in mean age between two groups.



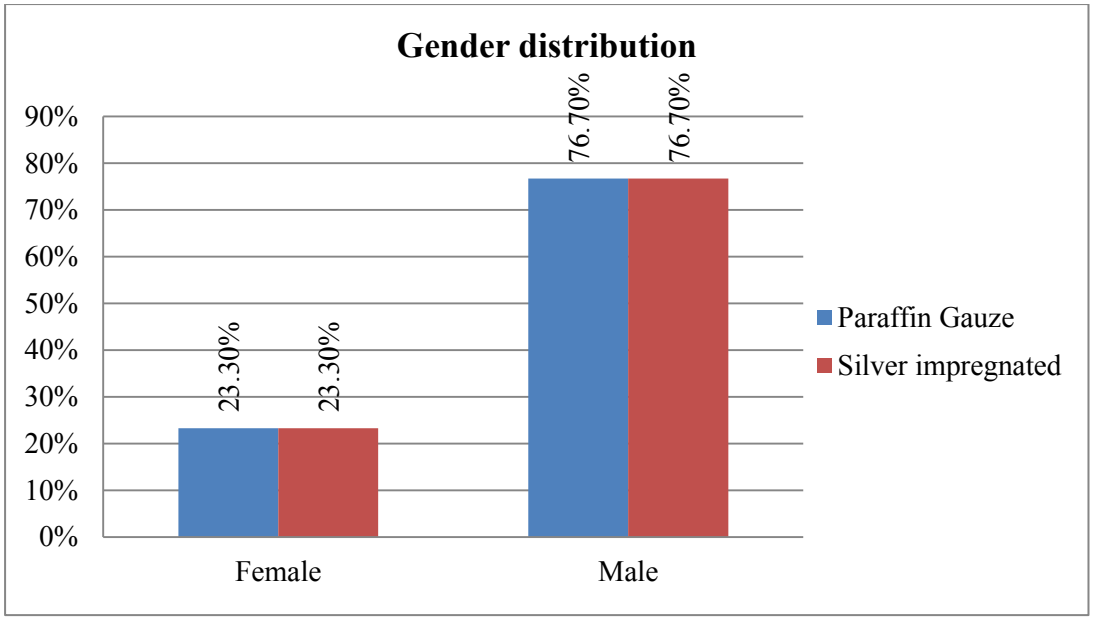
Graph 2: Bar diagram showing Mean age of subjects in both the groups

Table 3: Gender distribution of subjects between two groups

		Group			
		Paraffin Gauze		Silver impregnated	
		Count	%	Count	%
Gender	Female	7	23.3%	7	23.3%
	Male	23	76.7%	23	76.7%

$\chi 2 = 0.000$, df = 1, p = 1.000

In both the groups majority i.e. 76.7% were males and 23.3% were females. There was matching in gender distribution between two groups.



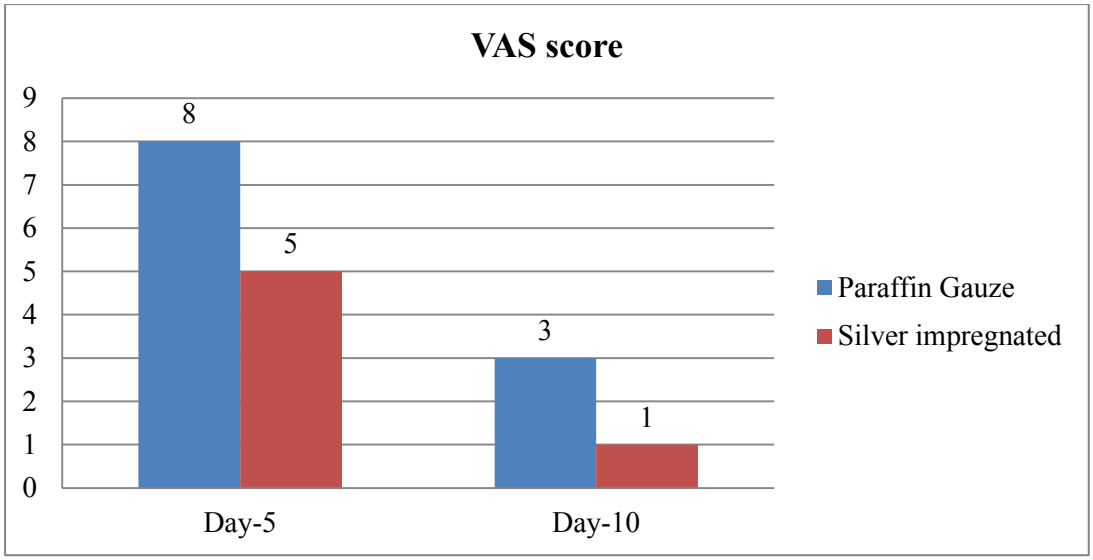
Graph 3: Bar diagram showing Gender distribution of subjects between two groups

Table 4: VAS score comparison between two groups at Day 5 and Day 10

VAS Score	Group						P value
	Paraffin Gauze			Silver impregnated			
	Mean	Median	SD	Mean	Median	SD	
Day-5	7.3	8	1.5	4.8	5	2.5	<0.001*
Day-10	3.4	3	1.8	1.7	1	1.0	<0.001*

*Mann Whitney U test

Median VAS score in Paraffin Gauze on Day 5 was 8 and on Day 10 was 3. Median VAS score in Silver impregnated group on Day 5 was 5 and on Day 10 was 1. This difference in median VAS score between two groups was statistically significant.



Graph 4: Bar diagram showing VAS score comparison between two groups at Day 5 and Day 10

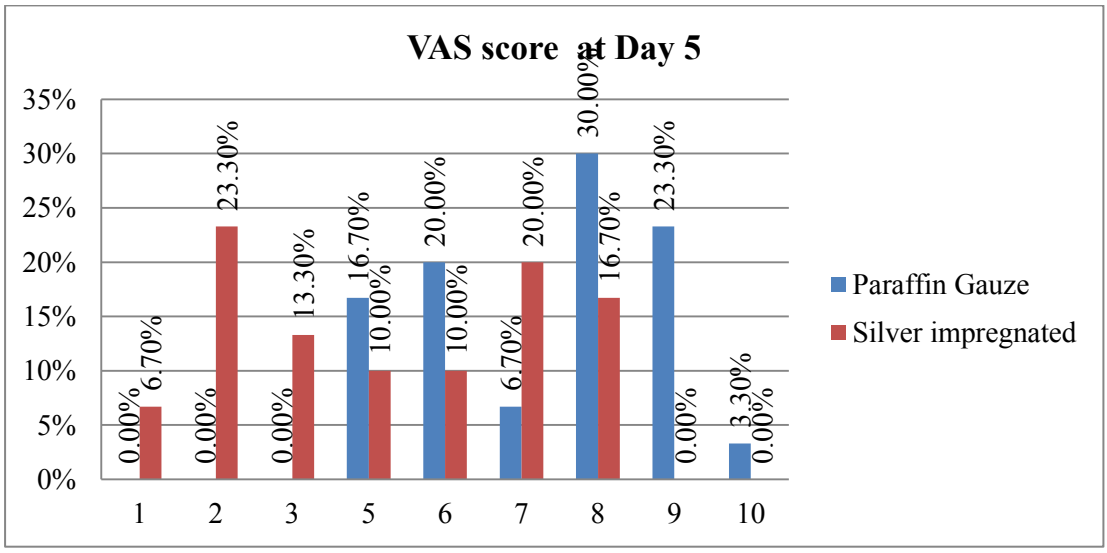
Table 5: VAS score distribution between two groups at Day 5 and Day 10

VAS Score		Group				P value
		Paraffin Gauze		Silver impregnated		
		Count	%	Count	%	
Day-5	1	0	0.0%	2	6.7%	<0.001*
	2	0	0.0%	7	23.3%	
	3	0	0.0%	4	13.3%	
	5	5	16.7%	3	10.0%	
	6	6	20.0%	3	10.0%	
	7	2	6.7%	6	20.0%	
	8	9	30.0%	5	16.7%	
	9	7	23.3%	0	0.0%	
	10	1	3.3%	0	0.0%	
Day-10	1	3	10.0%	16	53.3%	0.002*
	2	9	30.0%	11	36.7%	
	3	6	20.0%	2	6.7%	
	4	5	16.7%	0	0.0%	
	5	3	10.0%	0	0.0%	
	6	1	3.3%	1	3.3%	
	7	2	6.7%	0	0.0%	
	8	1	3.3%	0	0.0%	

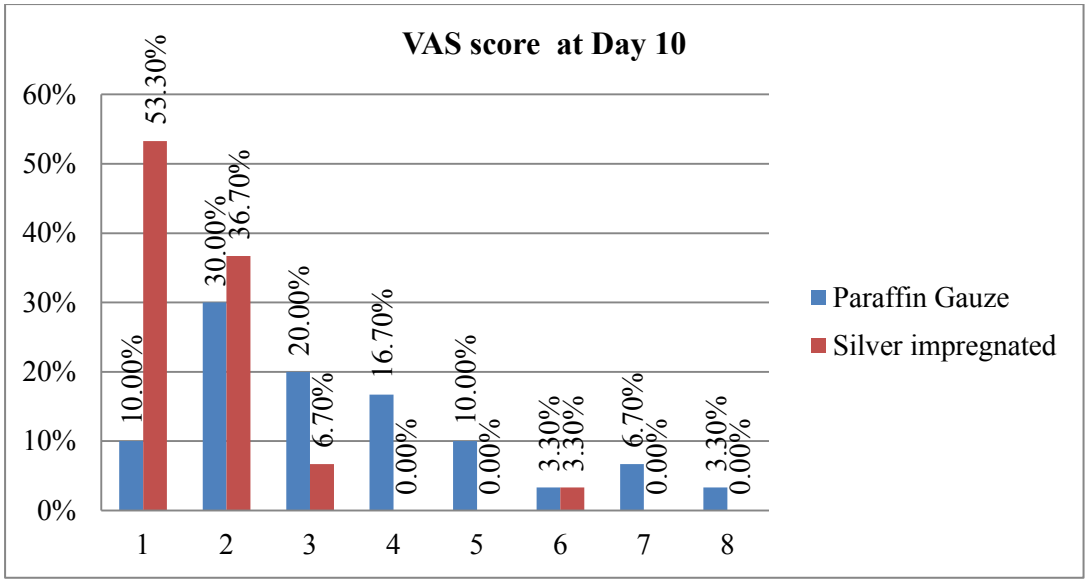
In Paraffin Gauze group on Day 5, majority of subjects had VAS score of 8 in 30%, followed by 9 in 23.3%. In Silver impregnated group, majority of subjects on Day 5

had VAS score of 2 (23.3%), followed by 7 in 20%. This difference in VAS score on Day 5 was statistically significant.

In Paraffin Gauze group on Day 10, majority of subjects had VAS score of 2 in 30%, followed by 3 in 20%. In Silver impregnated group, majority of subjects on Day 10 had VAS score of 1 (53.3%), followed by 2 in 36.7%. This difference in VAS score on Day 10 was statistically significant.



Graph 5: Bar diagram showing VAS score distribution between two groups at Day 5

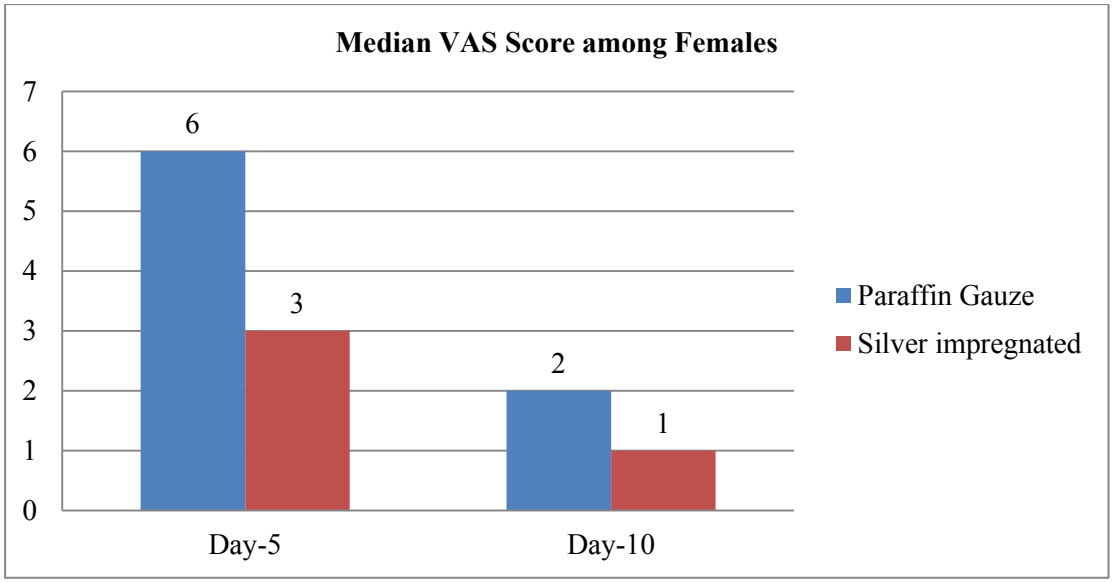


Graph 6: Bar diagram showing VAS score distribution between two groups at Day 10

Table 6: Median VAS Score comparison between two groups among Females

VAS Score	Group						P value
	Paraffin Gauze			Silver impregnated			
	Mean	Median	SD	Mean	Median	SD	
Day-5	7.0	6	1.3	3.7	3	2.0	0.007*
Day-10	2.7	2	2.1	1.4	1	0.5	0.209

Among Females Median VAS score in Paraffin Gauze on Day 5 was 6 and on Day 10 was 2. Median VAS score in Silver impregnated group on Day 5 was 3 and on Day 10 was 1. This difference in median VAS score in Females between two groups was statistically significant on Day 5, no significant difference was observed on Day 10.

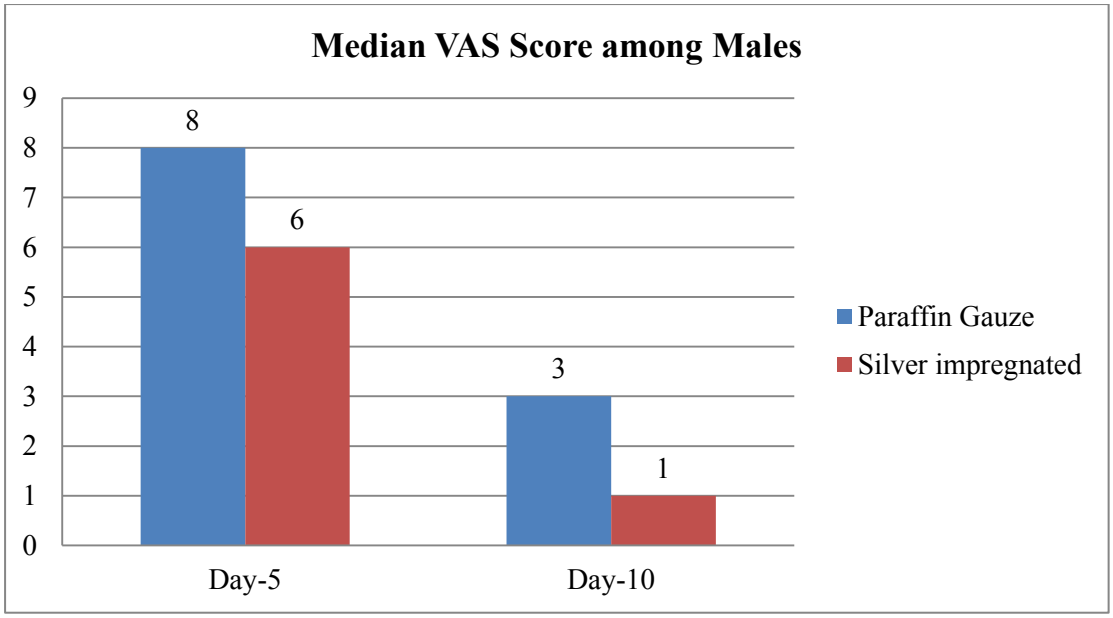


Graph 7: Bar diagram showing Median VAS Score comparison between two groups among Females

Table 7: Median VAS Score comparison between two groups among Males

VAS Score	Group						P value
	Paraffin Gauze			Silver impregnated			
	Mean	Median	SD	Mean	Median	SD	
Day-5	7.4	8	1.6	5.1	6	2.6	0.001*
Day-10	3.6	3	1.8	1.7	1	1.1	<0.001*

Among Males Median VAS score in Paraffin Gauze on Day 5 was 8 and on Day 10 was 3. Median VAS score in Silver impregnated group on Day 5 was 6 and on Day 10 was 1. This difference in median VAS score in males between two groups was statistically significant on Day 5 and Day 10.

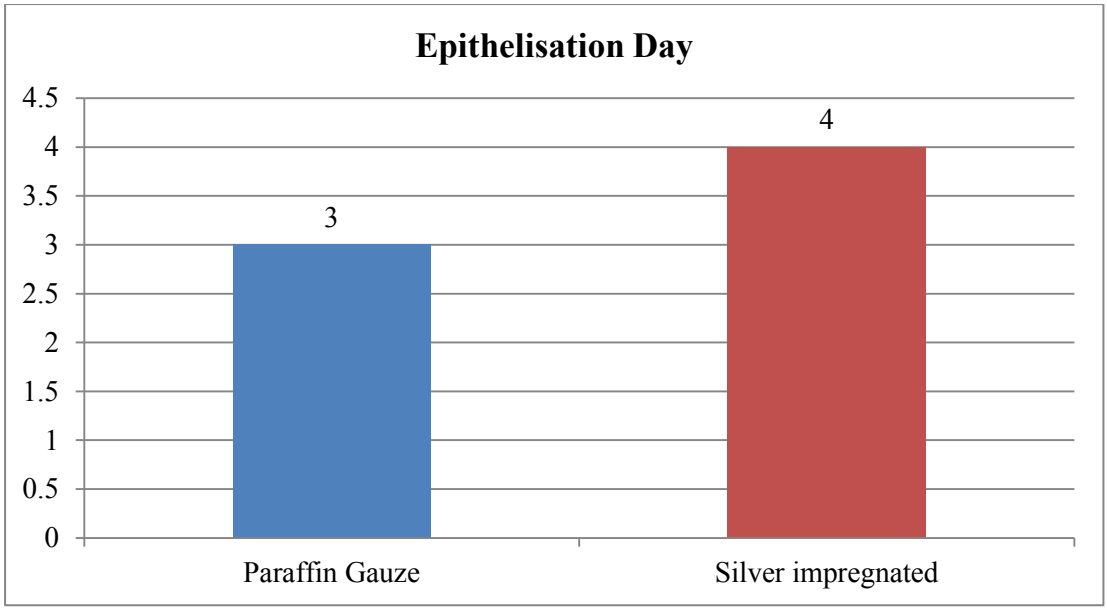


Graph 8: Bar diagram showing Median VAS Score comparison between two groups among Males

Table 8: Mean Day of Epithelisation comparison between two groups

	Group		P value
	Paraffin Gauze	Silver impregnated	
	Median	Median	
Epithelisation Day -14	3	4	<0.001*

Median Score of Epithelisation in Paraffin Gauze was 3 on day 14 and in Silver impregnated group was 4 on day 14. This difference in grade of epithelisation on day 14 between two groups was statistically significant.



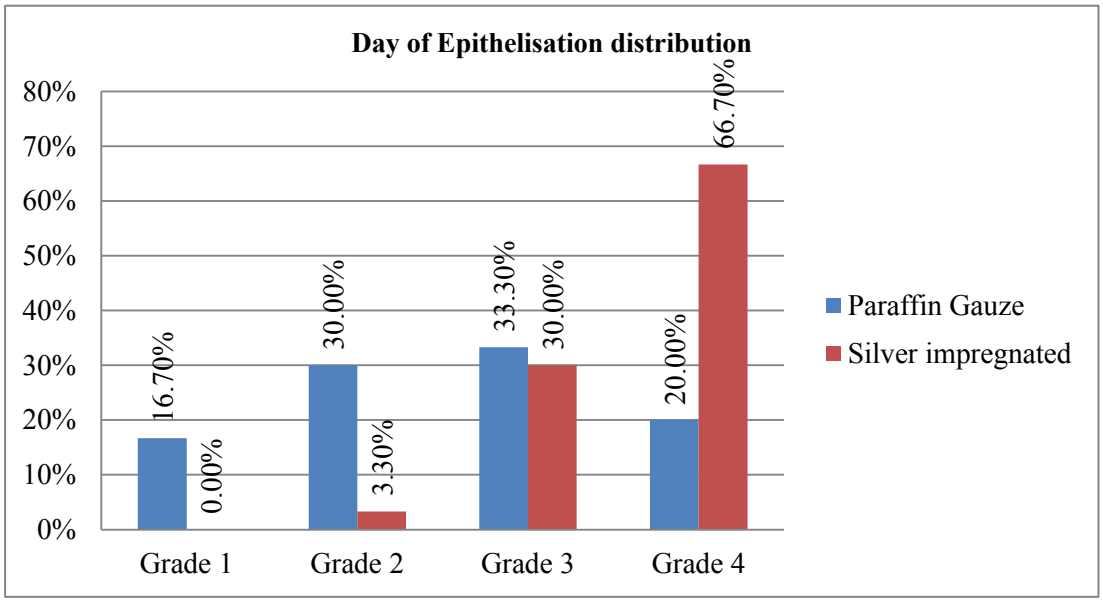
Graph 9: Bar diagram showing Mean Day of Epithelisation comparison between two groups

Table 9: Day of Epithelisation distribution comparison between two groups

Epithelisation Day-14		Group			
		Paraffin Gauze		Silver impregnated	
		Count	%	Count	%
Grade 1	Upto 25% Epithelised	5	16.7%	0	0.0%
Grade 2	25 to 50% epithelised	9	30.0%	1	3.3%
Grade 3	50 to 75% epithelised	10	33.3%	9	30.0%
Grade 4	>75% epithelised	6	20.0%	20	66.7%

χ 2 = 18.991, df = 3, p <0.001*

In Paraffin gauze group, 16.7% had grade 1, 30% had grade 2, 33.3% had grade 3 and 20% had grade 4 epithelisation on day 14. In Silver impregnated group, 0% had grade 1, 3.3% had grade 2, 30% had grade 3 and 66.7% had grade 4 epithelisation on day 14. Epithelisation was better in Silver impregnated group compared to Paraffin gauze group and was statistically significant.



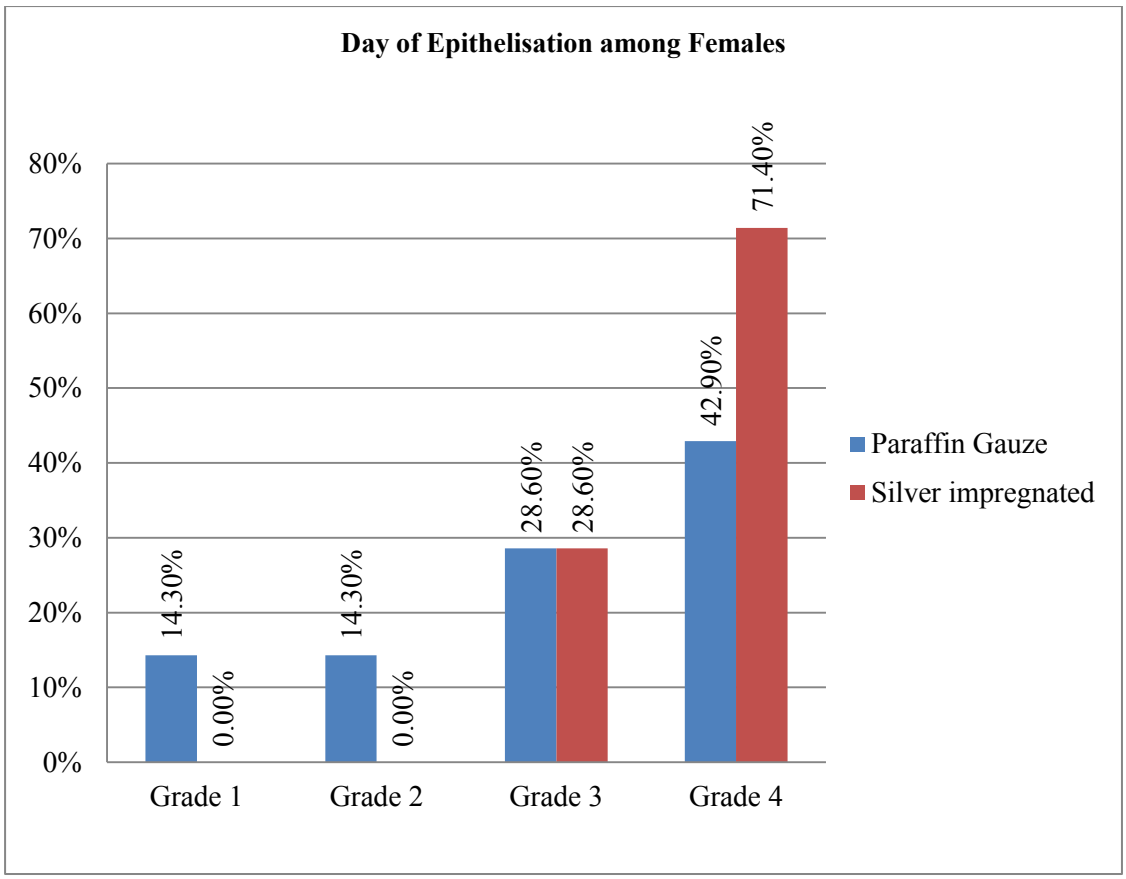
Graph 10: Bar diagram showing Day of Epithelisation distribution comparison between two groups

Table 10: Day of Epithelisation distribution comparison between two groups among Females

		Group			
		Paraffin Gauze		Silver impregnated	
		Count	%	Count	%
Epithelisation Day-14	Grade 1	1	14.3%	0	0.0%
	Grade 2	1	14.3%	0	0.0%
	Grade 3	2	28.6%	2	28.6%
	Grade 4	3	42.9%	5	71.4%

$\chi 2 = 2.500$, df = 3, p = 0.475

Among females in Paraffin gauze group, 14.3% had grade 1, 14.3% had grade 2, 28.6% had grade 3 and 42.9% had grade 4 epithelisation on day 14. In Silver impregnated group, 0% had grade 1, 0% had grade 2, 28.6% had grade 3 and 71.4% had grade 4 epithelisation on day 14. Epithelisation was better in Silver impregnated group compared to Paraffin gauze group, but was not statistically significant in females.



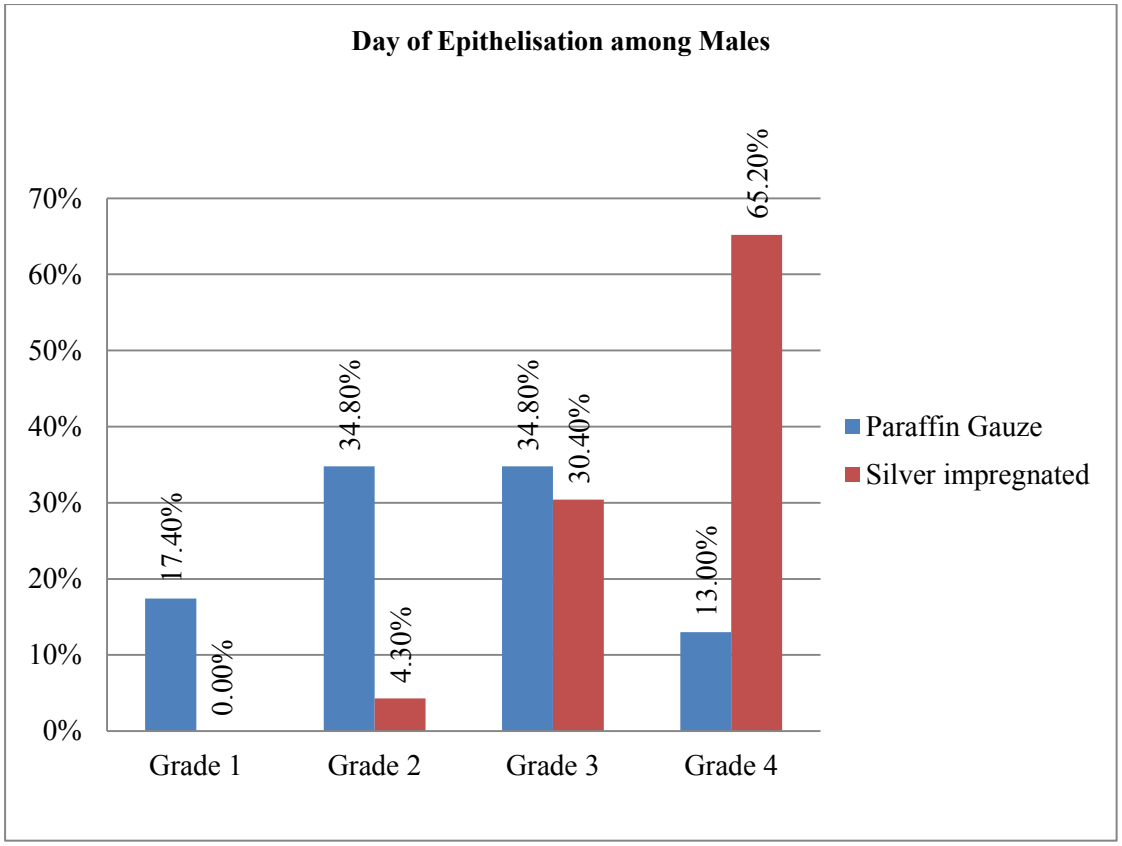
Graph 11: Bar diagram Day of Epithelisation distribution comparison between two groups among Females

Table 11: Day of Epithelisation distribution comparison between two groups among Males

		Group			
		Paraffin Gauze		Silver impregnated	
		Count	%	Count	%
Epithelisation Day-14	Grade 1	4	17.4%	0	0.0%
	Grade 2	8	34.8%	1	4.3%
	Grade 3	8	34.8%	7	30.4%
	Grade 4	3	13.0%	15	65.2%

$\chi 2 = 17.511$, df = 3, p = 0.001*

Among Males in Paraffin gauze group, 17.4% had grade 1, 34.8% had grade 2, 34.8% had grade 3 and 13% had grade 4 epithelisation on day 14. In Silver impregnated group, 0% had grade 1, 4.3% had grade 2, 30.4% had grade 3 and 65.2% had grade 4 epithelisation on day 14. Epithelisation was better in Silver impregnated group compared to Paraffin gauze group, and was statistically significant in Males.



Graph 12: Bar diagram showing Day of Epithelisation distribution comparison between two groups among Males

DISCUSSION

Split thickness skin grafting is a very commonly done reconstructive procedure. The donor site in split thickness skin grafting is traditionally dressed with paraffin gauze dressing for lubrication of the wound and left undisturbed till the dressing falls off after complete epithelisation of the site. This is associated with pain at the donor site, chances of infection of the donor site and such complications might lead to delay in wound epithelisation. To overcome these disadvantages, several types of dressings like hydrocolloid, silver impregnated, poly-urethane film, cellulose based and medicated tulle gras dressings are being tried.

The aim of the donor site dressing is to promote re-epithelisation, faster healing process, to reduce bacterial infection and contamination, to provide optimal moisture environment, be highly absorbent, nonadherent, reduce the pain and discomfort with better of wound care. Paraffin gauze dressing has been widely used on split-thickness skin graft donor sites with acceptable outcomes. Despite its advantages of allowing semiocclusive secondary dressing, low adherence, and cost effectiveness; the major drawback includes the epithelial damage during changing dressing, causing donor site pain, and discomfort. Hydrofiber dressing (sodium carboxy-methylcellulose hydrocolloid polymer; Aquacel, ConvaTec A Bristol-Myers Squibb) has been applied to various types of acute and chronic wounds, which revealed satisfactory results in many studies.

Silver impregnated dressings have been used to prevent and treat wound infections since a long time as the active agent, silver ions are potent antimicrobials while being non toxic to the human tissue. These dressings give protection to the wound site, prevent infection and maintain moist wound environment. These silver impregnated dressings are thus being tried in donor site of split thickness skin

grafting. Also the silver dressings are postulated to reduce the pain at the site by reducing inflammatory mediators.

In this study we compared the postoperative pain at the donor site and also epithelisation of the donor site with paraffin gauze dressings and silver impregnated dressings. The patients were divided into two groups of 30 each by a randomization plan. Accordingly the patients were dressed in the donor sites with paraffin gauze dressings or silver impregnated dressings and data collected and analysed.

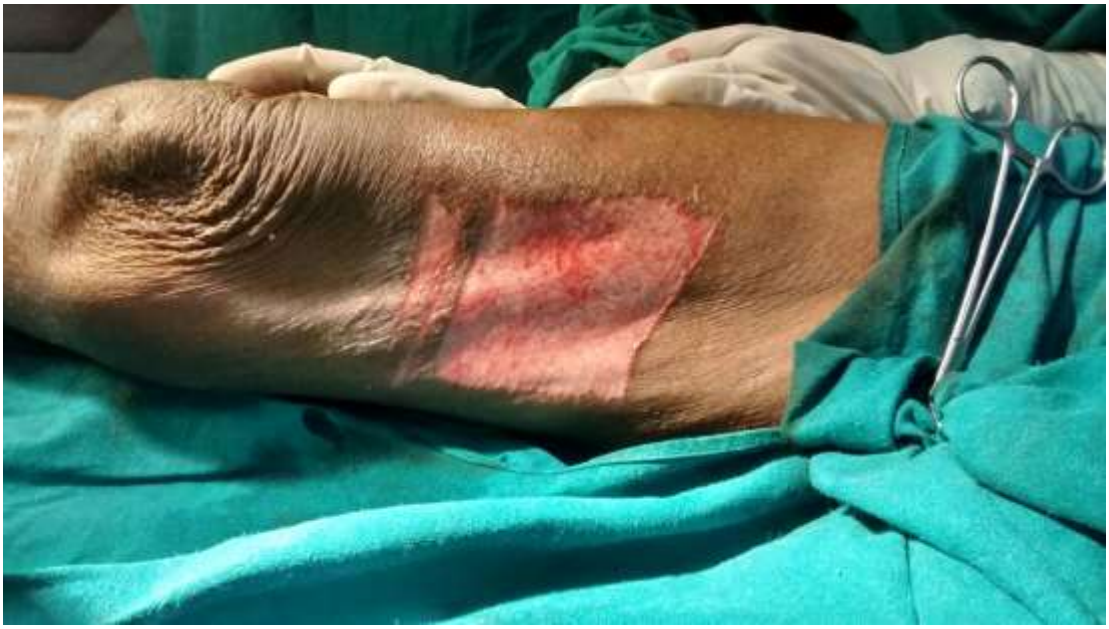


Fig. 19 Donor site after harvesting the graft.

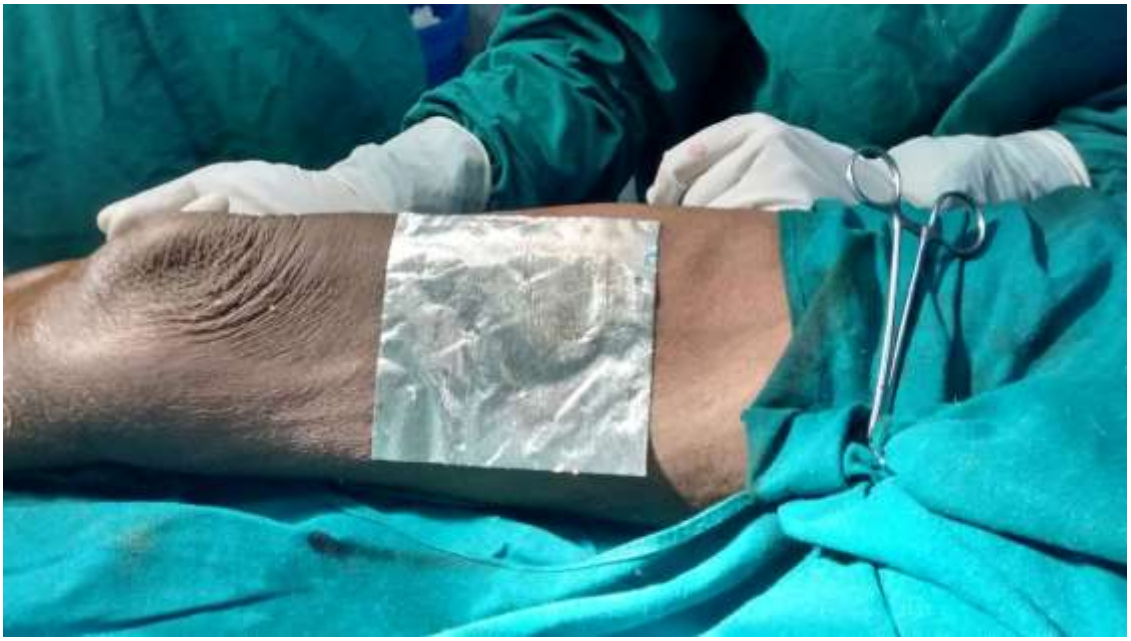


Fig. 20 After the application of silver impregnated dressing.

Analysis of data between the groups:

Pain:

In our study Median VAS score in Paraffin Gauze on Day 5 was 8 and on Day 10 was 3. Median VAS score in Silver impregnated group on Day 5 was 5 and on Day 10 was 1. This difference in median VAS score between two groups was statistically significant.

This is correlating with the study conducted by Lohsiriwat and Chuangsuwanich: Comparison of the Ionic Silver-Containing Hydrofiber and Paraffin Gauze Dressing on Split Thickness Skin Graft Donor Sites[77]. The average pain scores at rest in Silver containing hydrofiber dressing group and paraffin gauze group were 0.74 and 0.80, respectively (*P* _ 0.894). The average pain scores on dressing in group A and B were 3.12 and 4.70, respectively (*P* _ 0.027).

Another study conducted by Yener Demirtas, Caglayan Yagmur, Fatih Soylemez, Nuray Ozturk, Ahmet Demir: Management of split-thickness skin graft donor site: A

prospective clinical trial for comparison of five different dressing materials[1]. The VAS scores on day 4, 7 and 14 were 2.5, 2.2 and 1.2 with silver based dressings as compared to 4.5, 2.7 and 1.2 with paraffin based dressings which was statistically significant.

Another study conducted by Shaileshkumar M.E., Pramod Mirji, Vishwanath G., S.I. Basarkod, Chhaya Joshi, Rajani Patil: A Clinical Trial to Assess the Efficacy of Hydrocolloid versus Paraffin Gauze Dressing for Split Thickness Skin Graft Donor Site Treatment[2] shows that the pain at the donor site and also during dressing changes is less with semi occlusive dressings like hydrocolloid dressings as compared to plain paraffin gauze dressings.

Epithelisation:

In our study, Median Score of Epithelisation in Paraffin Gauze was 3 on day 14 and in Silver impregnated group was 4 on day 14. This difference in grade of epithelisation on day 14 between two groups was statistically significant.

This is correlating with the study conducted by Lohsiriwat and Chuangsuwanich: Comparison of the Ionic Silver-Containing Hydrofiber and Paraffin Gauze Dressing on Split Thickness Skin Graft Donor Sites[77]. The re-epithelization rate in Silver containing hydrofiber dressing group was 7.90 (range 4–13) days, while that in paraffin gauze group was 11.20 (range 4–19) days (*P* value- 0.031).

In the study conducted by Yener Demirtas, Caglayan Yagmur, Fatih Soylemez, Nuray Ozturk, Ahmet Demir: Management of split-thickness skin graft donor site: A prospective clinical trial for comparison of five different dressing materials[1]. Ninety percent epithelialization was obtained soonest in the donor sites dressed with silver based dressing, with a mean duration of 8.1days (range: 7–10 days) and the difference

was statistically significant (p = 0.001) in comparison with other dressings like paraffin based dressings.

Similarly the study conducted by Shaileshkumar M.E., Pramod Mirji, Vishwanath G., S.I. Basarkod, Chhaya Joshi, Rajani Patil: A Clinical Trial to Assess the Efficacy of Hydrocolloid versus Paraffin Gauze Dressing for Split Thickness Skin Graft Donor Site Treatment[2] showed the overall wound healing, as measured by percentage of epithelialized dermis, was faster with Hydrocolloid than with Paraffin gauze dressing. The number of donor areas that achieved complete epithelialization on the 12th post operative day by Standard paraffin gauze dressing were 7 (23.3%), whereas Hydrocolloid dressing achieved complete epithelialization in 18 patients (60%) (P = 0.016). This was similar to the results obtained by the earlier studies.

The results obtained were compared with other similar studies, showed that silver impregnated dressings provide better pain relief and also improve the epithelisation rate when compared to the regular paraffin gauze dressings.

Although other parameters like side effects of silver based dressings and cost of dressing were not considered in the study, the following observations are worth mentioning. The most common side effect with silver impregnated dressings is the staining of donor site or the surrounding skin.

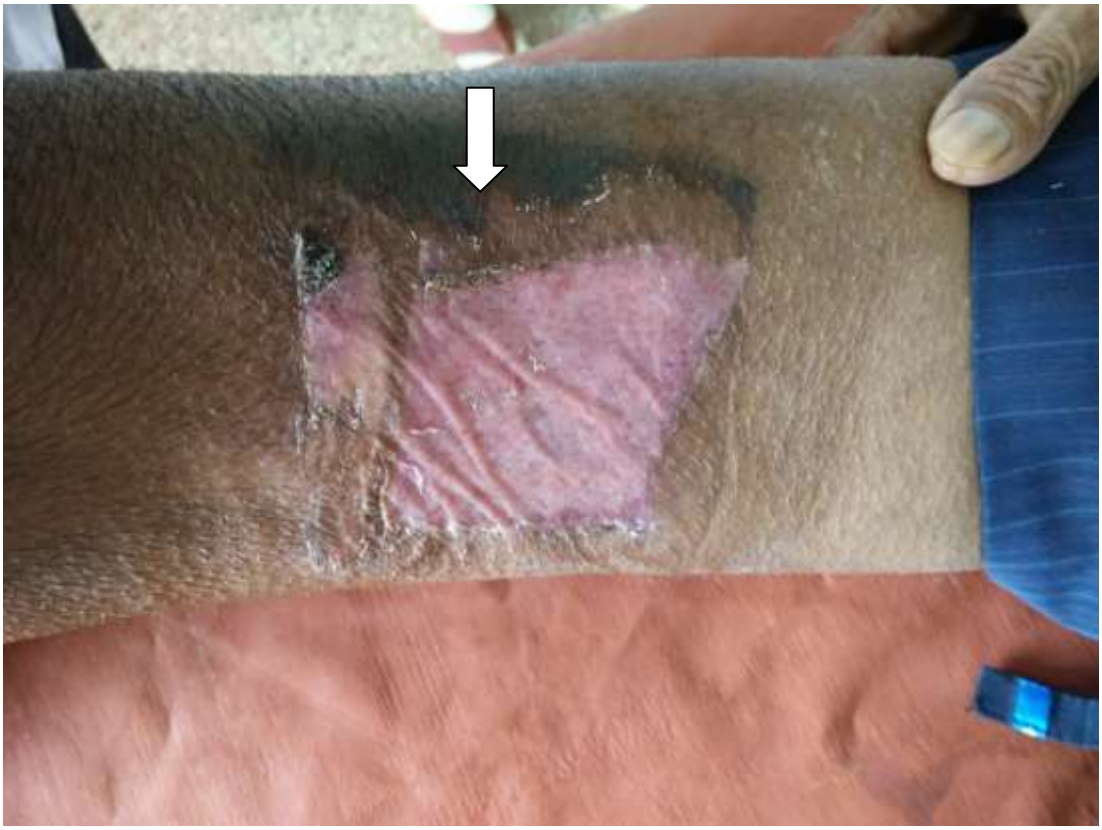


Fig. 21 Staining of skin surrounding the donor site (marked by arrowhead)

This staining of the skin was transient and resolved with no further intervention in the patients within 3 months. This local argyria is due to the deposition of silver sulphide or possibly minute particles of silver in the dermis in the region of the sweat glands and hair follicles[75]. It mostly occurs when silver is used as an antiseptic in mouthwashes or ingested in food[78]. It is not related to eczema or allergy, but a silver allergy may accompany argyria. We did not encounter patients with allergy to silver in our present study. Systemic argyria due to absorption of silver from the raw surface was documented in isolated case reports previously but was not encountered in the present study.

The donor site infection is a common side effect of SSG and is seen with all the types of dressings. In our study we had cases of donor site infection in both the groups. 8 patients in paraffin gauze group and 2 patients in silver impregnated dressing group

developed donor site infection and these patients were managed with regular dressings. The antibiotic property of silver is well established, hence the decreased incidence of donor site infection in this group can be attributed to this property of silver. This property also contributes to the faster healing in the patients by decreasing the local toxins due to bacterial colonization.

The cost of dressing in silver impregnated dressing group is considerably high when compared to the paraffin gauze group but this was not disadvantageous to the patient as the analgesic use in these patients was significantly less and also the duration of hospital stay was less. Hence the overall burden to the patient was probably less with silver impregnated dressings as compared to paraffin gauze dressings.

CONCLUSION

From the present study we conclude that,

- Epithelisation is faster with silver impregnated dressings as compared to paraffin gauze dressings.
- Post operative pain is lesser with silver impregnated dressings as compared to paraffin gauze dressings.

Hence, inspite of silver impregnated dressings being expensive compared to paraffin gauze dressings, silver impregnated dressings are preferable for the donor sites of split thickness skin grafting over paraffin gauze dressings as they reduce the duration of hospital stay as well as the use of analgesics, hence are economical to the patients in the long run.

SUMMARY

The present study titled **"Comparison between paraffin gauze dressings and silver impregnated dressings for the donor site of split thickness skin grafting"** was conducted in 60 patients who underwent split thickness skin grafting in Sri R.L.Jalappa medical college hospital and research centre , Kolar. The patients were divided into two groups A and B of 30 each according to block randomization.

Group A : 30 patients were dressed with paraffin gauze dressings at the donor site

Group B : 30 patients were dressed with silver impregnated dressings at the donor site

Epithelisation of the donor site and pain at the donor site were studied and compared between the two types of dressings.

Results obtained in our present study:

VAS Score (Median)	Group		P value
	Paraffin Gauze	Silver Impregnated	
Day-5	8	5	<0.001*
Day-10	3	1	<0.001*

Epithelisation Grade	Group		P value
	Paraffin Gauze	Silver Impregnated	
Day-14	3	4	<0.001*

In our study Median VAS score in Paraffin Gauze on Day 5 was 8 and on Day 10 was 3. Median VAS score in Silver impregnated group on Day 5 was 5 and on Day 10 was 1. This difference in median VAS score between two groups was statistically significant.

In our study, Median Score of epithelisation in Paraffin Gauze was 3 on day 14 and in Silver impregnated group was 4 on day 14. This difference in grade of epithelisation on day 14 between two groups was statistically significant.

Conclusions:

- Epithelisation is faster with silver impregnated dressings as compared to paraffin gauze dressings.
- Post operative pain is lesser with silver impregnated dressings as compared to paraffin gauze dressings.

Hence, inspite of silver impregnated dressings being expensive compared to paraffin gauze dressings, silver impregnated dressings are preferable for the donor sites of split thickness skin grafting over paraffin gauze dressings as they reduce the duration of hospital stay as well as the use of analgesics, hence are economical to the patients in the long run.

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ANNEXURE-I

PROFORMA

"COMPARISON OF PARAFFIN GAUZE DRESSINGS VERSUS SILVER IMPREGNATED DRESSINGS FOR DONOR SITE OF SPLIT THICKNESS SKIN GRAFTING".

Investigator: DR. K VIKAS SANKAR
Guide: DR. SHASHIREKHA. C.A

- **SL. No:** **Date:**
- **Name:**
- **Age:**
- **Occupation:**
- **Address:**
- **OP/ IP No:**

- **CHIEF COMPLAINTS:**

- **HISTORY OF PRESENT ILLNESS:**

  Onset

  Duration

  Progression

- **PAST HISTORY:**
- **FAMILY HISTORY:**
- **<u>ON EXAMINATION:</u>**

✓ **GENERAL PHYSICAL EXAMINATION:**

BULIT AND NOURISHMENT

PALLOR / ICTERUS / CLUBBING / CYANOSIS /

LYMPHADENOPATHY

VITALS :

- TEMPERATURE
- PULSE RATE
- BLOOD PRESSURE

✓ **SYSTEMIC EXAMINATION:**

CARDIOVASCULAR SYSTEM

RESPIRATORY SYSTEM

ABDOMEN

CNS

- **INVESTIGATIONS:**

✓ CBC

✓ BLOOD GROUPING AND TYPING

✓ BT, CT

✓ HIV

✓ HBsAG

✓ ECG

✓ CXR PA VIEW

✓ RBS

- ✓ RFT
- ✓ SERUM ELECTROLYTES

⦿ **PER OPERATIVE FINDINGS:**

⦿ **OPERATIVE NOTES:**

⦿ **PARAMETERS STUDIED:**

- ✓ VAS score Day5:
- ✓ VAS score Day10:
- ✓ Epithelisation Grade Day14:

Annexure-II

CONSENT FORM

Study title:COMPARISON OF PARAFFIN GAUZE DRESSINGS VERSUS SILVER IMPREGNATED DRESSINGS FOR DONOR SITE OF SPLIT THICKNESS SKIN GRAFTING

PG guide's name: Dr. SHASHIREKHA C.A

Principal investigator: DR. K. VIKAS SANKAR

Name of the subject:

Age :

Address :

a. I have been informed in my own vernacular language the purpose of the study, the necessity of relevant investigations to be carried out and photographs to be taken.

b. I understand that the medical information produced by this study will become part of institutional record and will be kept confidential by the said institute.
c. I understand that my participation is voluntary and may refuse to participate or may withdraw my consent and discontinue participation at any time without prejudice to my present or future care at this institution.
d. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).
e. I confirm that _____ (chief researcher/ name of PG guide) has explained to me the purpose of research and the study procedure that I will undergo and the possible risks and discomforts that I may experience, in my own language. I hereby agree to give valid consent to participate as a subject in this research project.

Participant's signature

Signature of the witness: Date:

I have explained to _____ (subject) the purpose of the research, the possible risk and benefits to the best of my ability.

Guide signature Date:

Annexure-III

A Randomization Plan
from
http://www.randomization.com

1. silver impregnated dressing_____
2. silver impregnated dressing_____
3. paraffin gauze dressing_____
4. silver impregnated dressing_____
5. paraffin gauze dressing_____
6. paraffin gauze dressing_____
7. silver impregnated dressing_____
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56. paraffin gauze dressing_____
57. silver impregnated dressing_____
58. paraffin gauze dressing_____
59. silver impregnated dressing_____
60. paraffin gauze dressing_____

60 subjects randomized into 2 blocks
To reproduce this plan, use the seed 9403
Randomization plan created on 18/11/2015, 10:38:09 PM

ANNEXURE - IV

MASTER CHART

SERIAL NUMBER	PATIENT ID	AGE (in years)	SEX	DRESSING USED	VAS SCORE (Day-5)	VAS SCORE (Day-10)	EPITHELISATION GRADE (Day -14)
1	218263	45	MALE	Silver impregnated	2	1	4
2	208598	65	MALE	Silver impregnated	3	1	4
3	226598	60	MALE	Paraffin gauze	8	6	1
4	228598	65	MALE	Silver impregnated	2	1	4
5	237623	41	MALE	Paraffin gauze	5	3	2
6	234101	55	MALE	Paraffin gauze	6	2	2
7	237605	41	FEMALE	Silver impregnated	3	2	4
8	222839	55	MALE	Silver impregnated	1	1	3
9	247737	32	MALE	Paraffin gauze	5	2	2
10	216245	65	FEMALE	Paraffin gauze	6	2	3
11	247808	65	MALE	Silver impregnated	2	1	4
12	236016	35	FEMALE	Paraffin gauze	8	7	1
13	237966	30	MALE	Paraffin gauze	5	2	3
14	245385	64	MALE	Silver impregnated	8	6	2
15	235462	65	FEMALE	Paraffin gauze	6	1	4
16	255606	65	MALE	Silver impregnated	2	1	4
17	253722	50	MALE	Paraffin gauze	5	2	2
18	69612	63	MALE	Silver impregnated	3	1	3
19	275980	45	FEMALE	Silver impregnated	2	1	4
20	262450	65	MALE	Paraffin gauze	9	7	1
21	269462	63	FEMALE	Silver impregnated	3	2	3
22	283015	65	MALE	Silver impregnated	2	1	4
23	266077	65	MALE	Paraffin gauze	8	8	1
24	286645	45	FEMALE	Silver impregnated	1	1	4
25	273518	60	MALE	Silver impregnated	2	2	3
26	303506	50	MALE	Paraffin gauze	8	3	3
27	298106	65	FEMALE	Paraffin gauze	6	2	4
28	302787	65	MALE	Silver impregnated	5	2	4
29	299293	24	MALE	Paraffin gauze	7	3	3
30	283622	65	MALE	Paraffin gauze	8	4	2
31	303088	65	FEMALE	Silver impregnated	6	2	3
32	287482	58	MALE	Paraffin gauze	9	4	2
33	309215	45	MALE	Silver impregnated	7	3	3
34	119555	60	FEMALE	Paraffin gauze	8	2	4
35	320492	65	MALE	Paraffin gauze	8	4	3
36	314210	65	MALE	Paraffin gauze	10	5	1
37	325847	50	MALE	Silver impregnated	8	2	3
38	337052	28	MALE	Paraffin gauze	6	2	4
39	294718	60	MALE	Silver impregnated	7	1	4
40	338166	60	MALE	Paraffin gauze	9	3	3
41	334478	47	MALE	Silver impregnated	8	3	3
42	342937	57	MALE	Silver impregnated	8	1	4
43	350844	33	MALE	Paraffin gauze	5	1	4
44	336543	30	MALE	Silver impregnated	7	2	4
45	357627	65	MALE	Paraffin gauze	8	3	3

SERIAL NUMBER	PATIENT ID	AGE (in years)	SEX	DRESSING USED	VAS SCORE (Day-5)	VAS SCORE (Day-10)	EPITHELISATION GRADE (Day -14)
46	334922	28	FEMALE	Silver impregnated	6	1	4
47	350982	60	MALE	Paraffin gauze	9	3	3
48	359093	65	FEMALE	Paraffin gauze	6	1	3
49	349629	28	FEMALE	Silver impregnated	5	1	4
50	374174	42	FEMALE	Paraffin gauze	9	4	2
51	378861	24	MALE	Silver impregnated	7	2	3
52	379845	28	MALE	Silver impregnated	7	1	4
53	379752	57	MALE	Silver impregnated	6	2	4
54	346181	61	MALE	Paraffin gauze	8	5	3
55	365200	55	MALE	Silver impregnated	5	1	4
56	408070	50	MALE	Paraffin gauze	9	5	2
57	425900	45	MALE	Silver impregnated	7	2	4
58	408103	57	MALE	Paraffin gauze	7	2	4
59	443855	65	MALE	Silver impregnated	8	2	4
60	447818	63	MALE	Paraffin gauze	9	4	2