J Orthop Sports Med 2019; 1 (1): 001-017 *DOI: 10.26502/josm.5115001*

Review Article

A Thoroughgoing Detail of Surgical Dressings

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Received: 04 December 2018; **Accepted:** 28 December 2018; **Published:** 09 January 2019

Abstract

Surgical enrichment/dressings are applications for wounds, burns, and ulcers. They should be regarded as supportive of healing; are desirable but not essential in an emergency. There are currently hundreds of dressings on the market to aid in wound management. Before selecting a dressing for a particular wound, a practitioner must assess carefully the needs of the wound to understand which dressing would provide maximal benefit. Frequently, there is not one clear best choice, and it is crucial that the pros and cons of each dressing modality be understood. This article has provided a framework to assist in dressing assessment. This article reviews measurement of wound healing and the functions of wound dressings. A variety of dressings and their respective details are discussed.

Purpose of the study: Discussion and projection of surgical supplies.

Findings: Modern world and technology gave rise to various way of wound healing with enrichments. Almost all sorts of enrichments are available in surgical outlets, a few of them are confined to hospital settings.

Materials and Methods: Research conducted a comprehensive year-round literature search, which included books, technical newsletters, newspapers, journals, and many other sources. Medicine and surgery experts, company executives and sales people were interviewed. Projections were based on different types of surgical supplies available in home and abroad.

Research limitations: Pictorial presentation of so many types of dressings are not possible to reproduce in an article but for a quick review, the article comprises most of them. Also, sutures are not detailed which will be encompassed by the next article

Practical implication: The soul of this article was to detail several types of surgical supplies. Along with students, researchers and professionals of different background and disciplines, e.g. Pharmacists, marketers, doctors, nurses, hospital authorities, surgery associates, therapists have to acquire much from this article.

Keywords: Wound Dressing; Gauzes; Absorbent; Cotton Fiber; Mesh; Sponges; Napkins

1. Introduction

A professional service rendered by many pharmacists consists of supplying surgical instruments, sutures, surgical dressings, and other equipment employed by the surgical personnel during and after a surgical operation. Some pharmacists who have obtained the necessary background of information carries a complete line of such supplies and even are able to provide operating tables and other heavy equipment. There are comparatively few such completely equipped pharmacies; the major outlet is through surgical supply houses. Every pharmacist, however, should be familiar with two of the products mentioned above, namely, Surgical Dressings and Sutures, which are discussed in detail below. The selection of the correct type of surgical dressing or suture is a critical factor in safeguarding the welfare of the patient undergoing surgery. Many items in these categories are handled routinely by pharmacists, and all of these items come within the purview of their professional responsibility.

1.1 Uses of dressings

Surgical dressing is a term applied to a wide range of materials used for dressing wounds or injured or diseased tissues. Dressings may serve to

- Provide an environment for moist wound healing. Desiccation of a wound is a major factor in retarding wound healing and increasing scarring. Dressings that prevent desiccation provide an optimal environment for autolysis cell migration, granulation, and re-epithelialization.
- Prevent maceration by permitting evaporation or absorption. In highly exudative wounds, excessive moisture and autolytic enzymes will damage repairing tissue and will provide a perfect culture medium for microbes.
- Promote hemostasis.
- Protect the wound from further damage (mechanical damage, microbial invasion, dehydration, maceration, chemical damage, alteration in pH).
- Reduce heat loss.
- Control microbial growth (by incorporation of antimicrobial drugs).
- Promote autolysis.
- Promote healing.
- Provide compression, promoting hemostasis, and reducing edema.
- Provide support.
- Reduce pain, increase patient comfort, and improve functional use ofwound site.
- Reduce odor.

- Improve the appearance of the wound site.
- Reduce overall costs associated with wound treatment.

1.2 Selection of wound dressing

Dressing selection should be made on the basis of the degree of exudation, presence or likelihood of infection, presence of necrotic tissue, and anatomical site. The correct selection of a wound dressing depends not only on the type of wound but also on the stage of repair. The use of a wound dressing cannot be considered in isolation, but rather in the context of an integrated wound-care program.

1.3 Types of wound dressings

Within this classification, dressings are considered on the basis of composition.

- Primary/secondary wound dressings
- Secondary dressings
- Absorbents
- Bandages
- Adhesive tapes
- Protectives

1.4 Specifications

Surgical dressings and sutures are required to meet specific requirements of the USP for many characteristics. For these specific requirements and the performance of several of the official tests, eg, Absorbency test and Fiber length of cotton, Diameter of sutures, and Tensile strength of sutures, textile fabrics, and films refer to the detailed instructions provided in the USP.

2. Classification

Functionally, the simplest method of classification uses the terms primary and secondary dressing. A primary dressing directly contacts the wound. It may provide absorptive capacity and may prevent desiccation, infection, and adhesion of the secondary dressing to the wound. A secondary dressing is placed over a primary dressing, providing further protection, absorptive capacity, compression, or occlusion. Although some dressings are solely primary or secondary in nature, others have the characteristics of both. The following classification is used here:

2.1 Primary wound dressings

2.1.1 Plain gauze: Plain gauze has been used as a primary dressing but will stick to all but clean, incised wounds. Although this property has been used to debride exudative, infected, and necrotic wounds, this practice may be painful and is often counterproductive, causing the removal of granhhulation tissue and new epithelium.

2.1.2 Impregnated gauze: Impregnated Gauze is used to reduce its adherence to wounds. Cotton, rayon, or cellulose acetate gauze has been impregnated with a variety of substances such as petroleum or paraffin (Aquaphor, Beiersdorf, Vaseline (Sherwood), KY jelly (Johnson & Johnson), petrolatum emulsion (Adaptic, Johnson & Johnson), zinc saline (NutraDress, Derma Sciences), or sodium chloride (mesalt, SCA Molnlycke). Coatings may wear off, allowing epithelial ingrowth and necessitating a dressing change. A secondary dressing should be used with these dressings to prevent desiccation, provide absorbency, and prevent the entrance of pathogens. When used with an appropriate secondary dressing, these dressings may be used in heavily exuding wounds.

2.1.3 Film dressings: Film Dressings (transparent film, occlusive or semi-occlusive) are films of polyurethane with acrylic or polyether adhesives that provide a semipermeable membrane to water vapor and oxygen yet are waterproof. In lightly exuding wounds they permit enough evaporation to promote moist wound healing and prevent maceration. Film dressings exclude bacteria from wounds and permit bathing and observation of the wound. Film dressings will adhere well to intact skin and have a low adherence for wound tissue. They should not be used in infected or heavily exuding wounds. Film dressings may wrinkle, forming channels for microbial entrance. Difficulty in handling film dressings has been overcome by special design of various application systems. In addition to their use as wound dressings, adhesive films have been used to protect areas vulnerable to pressure, friction, or shear ulceration or for infusion or cannulation sites. Examples of transparent film dressings are Bioclusive (R) Transparent Dressing (Johnson & Johnson), Opsite (Smith & Nephew), Tegaderm (3M), and Dermasite (Derma Sciences).

2.2 Primary/secondary wound dressings

2.2.1 Composite dressings: Composite dressings have primary and secondary components that prevent adherence to the wound, with some degree of absorbency. The degree of occlusion provided by these dressings varies. Release (Johnson & Johnson), Telfa (Kendall), and Melolin (Smith and Nephew) consist of lightly absorbent rayon or cotton pads sandwiched between porous polyethylene films. Nu-Derm (Johnson & Johnson) and Lyofoam A (Seton Healthcare Group) consist of polyurethane foams with a film backing.

2.2.2 Hydrogels: Hydrogels are complex lattices in which the dispersion medium is trapped rather like water in a molecular sponge. The hydrogel is typically a cross-linked polymer such as polyvinylpyrrolidone, cross-linked polyethylene oxide gel, or polyacrylamide. Hydrogels are nonadherent dressings that through semipermeable film allow a high rate of evaporation (and cooling) without compromising wound hydration. This makes them useful in burn treatment. Hydrogels are also very useful in hairy areas where entrapment of hair into the dressing would not be traumatic. Examples of hydrogels are Geliperm (Geistlich), Vigilon (Bard), Flexderm (Dow Hickam), and Nu-Gel (Johnson & Johnson). The latter is held together with a fusible fiber scrim.

2.2.3 Hydrocolloid dressings: Hydrocolloid dressings combine the benefits of occlusion and absorbency. Hydrocolloids are dispersions of particles around which water molecules and solvated ions form a shelllike structure. Fluid absorption occurs principally by particle swelling and enlargement of this structure. The

hydrocolloid mass of these dressings consists of gum-like materials, such as guar or karaya, sodium carboxymethylcellulose, and pectin, bound by an adhesive such as polyisobutylene. Hydrocolloid dressings display wet tack (adhesion to a wet surface) because of particle swelling. This property facilitates atraumatic removal. The dry tack of hydrocolloid dressings is due to an adhesive such as polyisobutylene, which is inactivated by moisture. The dry tack retained by the dressing around the wound preserves the edge seal. Exudate absorption by most hydrocolloid dressings results in the formation of a yellow/brown gelatinous mass that remains on the wound after dressing removal. This may be irrigated from the wound and should not be confused with pus. Because hydrocolloids absorb water slowly, they are of little use on acutely exuding wounds. They are, however, very useful for moderately to highly exudative chronic wounds. Examples of hydrocolloid dressings include Duoderm (ConvaTec), Comfeel Plus (Coloplast), and RepliCare (Smith & Nephew).

2.2.4 Calcium alginate dressings: Alginic acid is a naturally occurring polysaccharide derived from brown seaweeds. As the calcium salt, these fibrous nonwoven dressings are highly absorbent and are used on moderately to highly exuding wounds. They may be held in place with gauze tape or a film dressing. They also may be used to pack wounds. Examples of calcium alginate dressings are Sorbsan (Dow Hickam), Algosteril (Johnson & Johnson), and Kaltostat (Calgon Vestal).

2.3 Secondary wound dressings

2.3.1 Absorbents surgical cotton: Cotton is the basic surgical absorbent. It is official Purified Cotton USP. Domestic cotton grown in the Southern US is suitable for surgical purposes. The domestic cotton plant reaches a height of 2 to 4 ft. Growing from the seeds is a pod or boll that bursts open upon ripening, exposing a mass of white cotton fibers. Each of these fibers is a minute, hair-like tube, the outer wall being pure cellulose, the opening filled with plant fluids. When the boll bursts open, the fiber collapses into a flat ribbon-like form, twisted and doubled upon itself more than 100 times from end to end. The raw cotton fiber, mechanically cleaned of dirt and carded into layers but not otherwise treated, has a limited use for paddings and coverings of unbroken surfaces. This form is supplied under the name nonabsorbent cotton. It also is used frequently as cotton plugs in the bacteriological laboratory because of its non-absorbency. Absorbent Cotton is prepared from the raw fiber by a series of processes that remove the natural waxes and all impurities and foreign substances and render the fibers absorbent. It is a practically pure, white cellulose fiber. Besides the familiar roll form, Purified Cotton may be obtained in various prepared forms such as cotton balls or cotton-tipped applicators. Absorbent balls made of a uniform surgical viscose-rayon fiber also are available. These absorb fluids faster and retain their shape better than cotton balls.

Nonabsorbent Bleached Cotton, prepared by a modified bleaching process that retains the water-repellent natural oils and waxes, also is available. This cotton is identified easily by its silky feel. Because it is repellent to water, it does not become matted or inelastic. Consequently, it is well-adapted to packing, padding, and cushioning of dressings over traumatized areas and as nonabsorbent backing on sanitary napkins, combines, and drainage dressings. Rayon, or regenerated cellulose, is made from wood or cotton linters. After dissolving it in a mixture of alkali and carbon disulfide, cellulose thread is reprecipitated in an acid-coagulating bath by passage through fine

holes in a metal plate. Because plant lignins have been removed, as well as the more circular cross section, rayon fibers are softer and more lustrous than cotton.

2.3.2 Surgical gauzes: The function of surgical gauze is to provide an absorbent material of sufficient tensile strength for surgical dressings. It is known as Absorbent Gauze USP. In the process of making surgical gauze, the raw cotton fiber is cleaned mechanically and then spun or twisted into a thread, and the thread in turn is woven into an open-mesh cloth that is gray and nonabsorbent. It is bleached white and rendered absorbent by much the same processes as those used in the preparation of surgical cotton. The gauze thus treated is dried by passing a continuous length through a tentering machine. Tenterhooks straighten, stretch, and hold it taut as it is dried. When it leaves this apparatus, the dried gauze is cut into lengths, folded, rolled, and packaged. Gauze is classified according to its mesh, or number of threads per inch. Some types of surgical dressing require a close-meshed gauze for extra strength and greater protection, while other uses such as primary wound dressings, absorbent secondary dressings, and larger dressings to absorb purulent matter or other drainage require softer, more absorbent gauzes with a more open structure. Various forms of pads, compresses, and dressings are made from surgical gauze, alone or in conjunction with absorbent cotton, tissue paper, and other materials. Filmated Gauze is a folded absorbent gauze with a thin, even film of cotton or rayon distributed over each layer. This filmation fluffs up and gives ample dressing volume, yet costs less than gauze alone of equivalent volume. It possesses quick absorption and unusual softness.

Nonwoven Surgical Sponges-Nonwoven fabrics have been developed that are suitable alternatives to woven cotton gauze for use in wound cleaning, wound dressing, and tissue-handling. These nonwoven fabrics depend on dense entanglement of their synthetic fibers (Dacron, rayon, etc) to provide the fabric with an acceptable tensile strength approaching that of woven cotton gauze. They typically offer greater absorbent capacity than cotton gauze sponges of comparable bulk, while generating less lint. Specialty versions of the nonwoven sponges are available prefenestrated for IV tubing or draindressing procedures. One manufacturer (Johnson & Johnson) provides both a nonwoven sponge for wound dressing (Sof- Wick: very soft texture, very absorbent or Topper: highly absorbent, fewer dressing changes) and a nonwoven general-purpose cleansing/prep sponge (NuGauze: gauze-like texture, more absorbent than gauze). Additionally, a new universal sponge which combines the best attributes of woven and nonwoven gauze, has been created from a new fabric technology. Mirasorb (Johnson & Johnson) is made from a cotton blend, is more absorbent and resilient than woven gauze, provides less adherence to healthy tissue, and reduces wound damage and tissue trauma upon removal. Selvage-Edge Gauze Strips in widths of 1/4 to 2 inches are designed specially and woven for use both as packing strips in surgery of the nose and sinuses, nasal hemostasis, etc, and as drainage wicks in the treatment of boils, abscesses, fistulas, and other draining wounds. The ravelproof, selvage edges on both sides eliminate all loose threads. These gauzes are available unmedicated or medicated with 5% iodoform. These strips are obtainable in sterile form packed in sealed glass jars. Nu Gauze Packing Strips are packaged in polystyrene containers.

Gauze Pads or Sponges are folded squares of surgical gauze. These are so folded that no cut gauze edges or loose threads are exposed. This prevents loose fibers from entering the wound. The pads are folded such that each size

may be unfolded to larger sizes without exposing cut edges or loose threads. Sterilized packages of these frequently used allgauze sponges are available in tamper-proof packages. Such sterile units particularly are well-suited to the numerous tray sets prepared in hospitals. X-ray Detectable Gauze Pads are similar to all-gauze pads but contain inserts treated with barium sulfate. They are nontoxic, soft, and nonabrasive. They remain permanently detectable because they neither deteriorate in the body nor are affected by either sterilization or time. Examples of X-ray detectable sponges include Vistec and Kerlix (unique, crinkleweave, soft, and absorbent), both manufactured by Kendall. Ray-Tec X-Ray Detectable Sponges (Johnson & Johnson) contain a nonabrasive vinyl plastic monofilament that gives a characteristic pattern in the X-ray. Composite absorbent dressings have been developed for specific purposes. They usually consist of layers of absorbent gauze or nonwoven fabric with fillers of cotton, rayon, nonwoven fabric, or tissue paper in suitable arrangements. Composite sponges have gauze or nonwoven fabric surfaces with fillers of cotton, rayon, nonwoven fabric, or absorbent tissue.

2.3.3 Dressing combines: Dressing combines are designed to provide warmth and protection and to absorb large quantities of fluid that may drain from an incision or wound. Each combine consists of a nonwoven fabric cover enclosing fiber with or without absorbent tissue. They also may incorporate a nonabsorbent layer of cotton, tissue, or plastic film to prevent fluid from coming through to soil liners and bedding, though some combined dressings are entirely absorbent.

2.3.4 Laparotomy sponges: Laparotomy Sponges, also known as Abdominal Packs, Tape Pads or Packs, Walling-Off Mops, Stitched Pads, Quilted Pads, Gauze Mops, etc, are used to form a nonabrasive wall that will prevent abdominal or other organs from entering into the field of operation and to help maintain body temperature during exposure. They are made of four layers of 28 × 24 mesh gauze. The edges are folded in and hemmed. The entire pack is cross-stitched, and a looped tape 1/2-inch wide and 20-inches long is attached to one corner. A desirable feature of one type is an X-ray-detectable insert so firmly incorporated into the gauze that it cannot become detached. Treated with barium sulfate, the monofilament is nontoxic and, were it to be left inadvertently in situ, would cause no more foreign-body reaction than an ordinary dressing.

2.3.5 Sanitary napkins: Sanitary Napkins intended for special hospital use, otherwise known as V-Pads, Obstetrical (OB) Pads, Perineal Pads, Maternity Pads, etc, are used in obstetrical, gynecological, or maternity cases. Napkins that have repellent tissue on the side and back surfaces of the napkin usually are preferred because of their greater fluid-holding capacity. Sanitary napkins generally come with two sizes of filler, 3 × 9-inch or 3 × 11-inch. The napkin cover generally is made from a nonwoven fabric or a nonwoven fabric supported with an open-mesh scrim. Packaged, sterilized napkins are available and used generally to reduce cross-contamination possibilities.

2.3.6 Disposable cleaners: Disposable Cleaners made from various types of nonwoven fabrics are available. They generally offer advantages over paper in wet strength and abrasion resistance, plus having better cleaning ability. Their advantages over cloth are reduced laundry expense and cross-contamination possibilities.

2.3.7 Eye pads: Eye Pads are scientifically shaped to fit comfortably and cover the eye completely, thus protecting the eyebrow when taped. These pads are made using nonwoven fabric. Two sides are enclosed to prevent the cotton from escaping and the pad from distorting. When desired, the pad may be folded and used as a pressure dressing. Eye pads especially are useful in the outpatient clinic of the hospital, the industrial medical department, and the physician's office. They are sealed in individual sterile envelopes.

2.3.8 Nursing pads: Nursing Pads are designed in a contour shape to fit comfortably under the nursing brassiere or breast binder.

2.3.9 Disposable underpads: Disposable Underpads are used for incontinent, maternity, and other patients with severe drainage. Such pads cost less than the average hospital-made product and provide a neat, clean, easy-to-handle pad that is changed quickly and easily disposed. Disposable briefs are available (Johnson & Johnson, Kendall).

2.3.10 Cotton-Tipped Applicators: Cotton-Tipped Applicators are used to apply medications or cleanse an area. Machine-made cotton-tipped applicators are uniform in size, resulting in no waste of cotton or medications. The cotton is attached firmly to the stick and may be sterilized readily without affecting the anchorage of the cotton. They are available in 3- or 6-inch lengths.

2.4 Bandages

The function of bandages is to hold dressings in place by providing pressure or support. They may be inelastic, be elastic, or become rigid after shaping for immobilization.

2.4.1 Roller bandage: Roller bandage is listed in the USP as a form in which Absorbent Gauze may be provided. It is prepared from Type I Absorbent Gauze in various widths and lengths. Each bandage is in one continuous piece, tightly rolled and substantially free from loose threads and ravelings.

2.4.2 Muslin bandage: Muslin bandage Rolls are made of heavier unbleached material (56 ×60 mesh). They are supplied in the same widths as the regular gauze bandage. Muslin bandages are very strong and are used wherever gauze bandages do not provide sufficient strength or support. They frequently are used to hold splints or bulky compression dressings in place.

2.4.3 Elastic bandages are made in several types:

A. Woven Elastic Bandage is made of heavy elastic webbing containing rubber threads. Good support and pressure are provided by this type of rubber elastic bandage.
B. Crepe Bandage is elastic but contains no rubber. Its elasticity is due to a special weave that allows it to stretch to practically twice its length, even after repeated launderings. This elasticity makes it especially serviceable in bandaging varicose veins, sprains, etc, because it conforms closely to the skin or joint

surfaces, lies flat and secure, yet allows limited motion and stretches in case of swelling so that circulation is not impaired.

C. Conforming Bandage is made from two plies of specially processed, high-quality, 14 × 8-inch cotton gauze folded to the center. This type is much easier to use and apply than ordinary roller bandage, since it tends to cling to itself during application, thus preventing slipping. It readily conforms to all body contours without the necessity of reversing or twisting. A further advantage is the fact that there can be no rough or frayed edge. Kling Conforming Gauze Bandage and Sof-King Conforming Bandage (Johnson & Johnson) are available in a variety of sizes up to 6 inches wide. This gauze is used widely to hold dressings or splints firmly in place and occasionally as a primary dressing when sticking to the wound is not a problem. A mercerized cotton Conforming Gauze Bandage clings to itself and thus remains in place better than gauze made of other materials. Sof-King is a one-ply rayon and polyester blend bandage that provides greater bulk for cushioning and greater absorbency.

D. High-Bulk Bandage is made of multiple layers (typically six) of crimped cotton gauze. The high bulk of this bandage type is designed to provide padding protection in wound dressing applications. It also provides the absorbent capacity of a cotton dressing component. One version (Sof-Band High Bulk, Johnson & Johnson) is made of mercerized cotton to help the bandage cling to itself, which facilitates application and improves dressing stability.

E. Compression Bandage is composed of cotton knitted or woven with either viscose, polyurethane, nylon, or elastane threads. The bandage is comformable and easy to apply. Its use is primarily to maintain controlled levels of pressure when compression therapy is required. As with all compression bandages, these products should be utilized with caution on patients with marked peripheral ischemia or impaired arterial blood supply. Examples of compression bandge include Tensopress (Smith and Nephew), Yeinopress (Moliner), and Setopress (Seton Healthcare).

2.4.4 Triangular bandages: Triangular bandages usually are made by cutting a square of bleached muslin diagonally from corner to corner, forming two right triangles of equal size and shape. The length of the base is approximately 54 inches. These bandages were brought into prominence by Esmarch and still bear his name. They are used in first-aid work for head dressings, binders, and arm slings and as temporary splints for broken bones.

2.4.5 Orthopedic bandages: Orthopedic bandages are used to provide immobilization and support in the treatment of broken bones and in certain conditions of bones and joints. Plaster of Paris–impregnated gauze has been the standard material for this purpose. More recently introduced are synthetic cast materials made of polyester cotton or fiberglass. Various types of plastic sheets also are offered that can be shaped easily and hardened to a rigid form by cooling or chemical reaction. These are useful chiefly for splints and corrective braces. Individually packaged plaster of Paris bandages and splints are available in a wide variety of sizes. The Specialist brand (Johnson & Johnson) is made from specially treated plaster, uniformly spread and firmly bonded to the fabric. This results in a high strength-to-weight ratio in casts made from such bandages. Synthetic casts are applied like plaster of Paris. The

Delta-Lite Synthetic Casting System (Johnson & Johnson) offers both polyester, cotton fabric impregnated with a polyurethane resin, and fiberglass casting materials. Scotchcast Softcast (3M) consists of a knitted fiberglass substrate impregnated with a polyurethane resin containing a surface modifying agent (reduce tack, facilitate application). The casts are water-resistant, light weight, and durable.

2.4.6 Orthoflex elastic plaster bandages: Orthoflex elastic plaster bandages (Johnson & Johnson) are plaster of Paris bandages containing elastic threads in the fabric and are intended for specialized prosthetic uses. Stockinette Bandages are made of stockinette material knitted or woven in tubular form without seams. Surgical stockinette is unbleached. Because it is soft and will stretch readily to conform comfortably to the arm, leg, or body, it is used to cover the skin prior to the application of a plaster of Paris or synthetic cast.

2.4.7 Cast paddings: Cast paddings are soft, absorbent, protective paddings, applied like a bandage to the areas affected, before application of a cast. They are composed of various fiber constructions that conform and cling, absorb moisture, and allow the skin to breathe.

2.5 Adhesive tapes

Surgical adhesive tapes are made in many different forms, varying both in the type of backing and in the formulation of the adhesive mass according to specific needs and requirements. The tapes available today may be divided into two broad categories: those with a rubber-based adhesive and those with an acrylate adhesive. Both types have a variety of uses. When strength of backing, superior adhesion, and economy are required (eg, athletic strapping), rubber adhesives commonly are used. Acrylate adhesives on a variety of backing materials are used widely in surgical dressing applications, when reduced skin trauma is required, as in operative and postoperative procedures; they are supplied in various strength and adhesion levels.

2.5.1 Acrylate adhesives: Acrylate adhesives on a nonwoven or fabric backing have been accepted widely for use as surgical tapes, owing largely to what may be termed their hypoallergenic nature. Because acrylate adhesives are basically a uni-polymeric system, they eliminate the use of a large number of components in rubber-based adhesives. In poly(alkyl-acrylate) adhesives, the desired balance between adhesion, cohesion, and flow properties is determined by the choice of monomers and the control of the polymerization reactions. Once the polymer is made, no other formulating or compounding is needed. In addition, the acrylics have an excellent shelf-life because they are not affected readily by heat, light, or air, factors that tend to degrade rubber-based adhesives. Acrylate adhesives combine the proper balance of tack and long-term adhesion. Their molecular structure permits the passage of water vapor so they are nonocclusive and thus when coated on a porous backing material do not cause overhydration in the stratum corneum. Traumatic response to surgical tapes is minimized substantially when tapes are constructed to allow normal skin moisture to pass through adhesive and backing material. With this construction, the moisture content and strength of the horny cell layers remain relatively normal. When a porous tape is removed, the planes of separation develop near the surface of the stratum corneum, in the region of the naturally desquamating cells. This allows repeated use of tape over the same site with minimal damage to the skin. Hypoallergenic Surgical Tapes with

acrylate adhesive are available with a variety of porous backing materials. Rayon taffeta cloth backing provides a high-strength tape well-suited for affixing heavy dressings. Lighter dressing applications can be accomplished with lower-strength, economical, paperbacked surgical tapes. A knitted backing tape (Dermiform, Johnson & Johnson) provides some of the economies of paper surgical tape with the strength and conformability of a cloth backing. Other tapes feature elastic cloth or foam backing materials for special taping needs.

2.5.2 Rubber-based adhesives: A second group of surgical adhesive tapes is the cloth-backed and plastic-backed rubber adhesives. These are used principally where heavy support and a high level of adhesion are required. Modern rubber-based adhesive tape masses consist of varying mixtures of several classes of substances and are composed of an elastomer (para or pale crepe rubber in the case of natural rubber tapes, and synthetic elastomers made from polymers of isobutylene, alkyl-acrylate, or similar materials), one of several types of rosin or modified rosin, antioxidants, plasticizers and fillers, and coloring agents to give the tape the desired tint or whiteness.

2.5.3 Adhesive tape reactions: While skin reactions formerly were accepted by the medical profession as almost predictable sequelae to the use of adhesive tape, with better understanding of the mechanisms of such reactions and progress in research and technology, the long-sought-for objective of hyporeactivity has, in large degree, been attained. Because adhesive tape masses historically have consisted of heterogeneous and complex mixtures of organic compounds, it is not surprising that many workers have ascribed adhesive tape reaction to allergy. More-recent work, however, has shown that a true allergic response to the modern adhesive tape mass or its components is a factor in only a small proportion of clinical reactions and that most observed reactions are ascribed properly to other factors, mainly mechanical irritation and, to a lesser degree, chemical irritation. There apparently is no significant difference in reaction between patients with or without a history of allergy, but true specific dermatitis may occur more readily in persons who have manifested some other form of contact dermatitis. Adverse manifestations produced by adhesive tape are characterized by erythema, edema, papules, vesicles, and in severe cases, desquamation. Itching may be intense, or it may be absent. The reaction may be demonstrated readily by patchtesting, and usually manifests itself early-within 24 to 48 hr. Characteristically, the reaction becomes more severe the longer the tape is left in place and continues to increase in intensity for some time after the tape is removed. This type of reaction is long-lasting and requires days for its complete subsidence.

Two distinct types of irritation can result from the mechanical dynamics of removing tape from the skin. One response-induced vasodilation-is a relatively nontraumatic, transitory effect in which no actual damage to the skin occurs. A second type-skin stripping-is a traumatic response in which skin is removed with the tape and actual damage to the epidermal layers results. Such mechanical skin removal is possibly the dominant cause of clinical reactions seen with the use of adhesive tape. Chemical irritation from adhesive tape results when irritating components in the mass or backing of the tape permeate the underlying tissues of the skin. The tape construction can influence the reactivity of such ingredients substantially. For example, many compounds that normally do not penetrate intact stratum corneum can penetrate overhydrated corneum. When portions of the stratum corneum are removed, the barrier capacity of the skin is damaged substantially. In this situation, any irritating components of the

tape have ready access to underlying tissues. These substances then can cause a degree of irritation that is far greater than would be observed on intact skin.

2.6 Protectives

Until recently, protectives included only the various impermeable materials intended to be used adjunctively with other dressing components to prevent the loss of moisture or heat from a wound site or to protect clothing or bed liners from wound exudate. Film dressings are excellent devices to protect against infection and dislodgement of vascular cannulae and drainage sites. In addition, they may be used to protect vulnerable areas against pressure sores. Protectives also are employed to cover wet dressings and hot or cold compresses. In common use as protectives are plastic sheeting and waxed or plastic-coated paper. These prevent the escape of moisture or heat from the dressing or the compress and protect clothing or bed linens. Rubber sheeting is a rubber-coated cloth, waterproof and flexible, in various lengths and widths for use as a covering for bedding. A so-called nursery sheeting is supplied, coated only on one side.

2.7 Products for adhesion prevention

Adhesions are abnormal connections between organs or tissues that form after trauma, including surgery. They consist of organized fibrin and fibrovascular scar tissue and complicate all areas of surgery. In gynecological surgery, adhesions may result in infertility and pelvic pain; in intestinal surgery they may result in intestinal obstruction; in cardiac surgery they may render a second sternotomy hazardous, and in tendon surgery they will prevent mobility. Although careful tissue handling and good hemostasis may reduce adhesion formation, there are few proven entities designed for the prevention of adhesions. Gynecare Interceed Absorbable Adhesion Barrier (Ethicon) is a knitted fabric of oxidized regenerated cellulose that is placed at a site where adhesions are suspected to occur. It swells and gels to form a barrier between two adjacent surfaces, allowing re-mesothelialization to take place. The fabric then degrades grossly by about 14 days and microscopically by about 28 days. Interceed Barrier is indicated for reducing the incidence of adhesions in pelvic gynecological surgery. Other mechanical barriers used for the prevention of adhesions include Seprafilm (Genzyme) and Gore- Tex Surgical Membrane (Gore). Newer products available for the prevention of postoperative adhesions that are not site-specific for application include Gynecare Intergel Adhesion Prevention Solution, a ferric hyaluronate gel (Lifecore Biomedical) and Sepracoat, a dilute hyaluronic acid solution (Genzyme).

2.8 Operating room supplies

2.8.1 Hemostatic products: Hemostatic products accelerate hemostasis by providing a thrombogenic surface that promotes platelet aggregation and fibrin polymerization. These topical hemostatic agents include collagen, gelatin, cellulose, and thrombin. These include collagen sponges and powders (Instat, Johnson & Johnson; Helistat, Integra Life Sciences; Actiofoam, Bard; Avitene, Davol; Helitene, Integra Life Sciences), gelatin sponges (Surgifoam, Johnson & Johnson; Gelfoam, Upjohn), and Oxidized Regenerated Cellulose USP (Surgicel, Johnson & Johnson). Both oxidized cellulose and oxidized regenerated cellulose are agents whose actions depend on the formation of a coagulum consisting of salts of polyanhydroglucuronic acid and hemoglobin. When applied to a bleeding surface,

they swell to form a brown gelatinous mass that is absorbed gradually by the tissues, usually within 7 to 14 days. They are employed in surgery for the control of moderate bleeding when suturing or ligation is impractical or ineffective.

2.8.2 Thrombin (USP) solutions: Thrombin (USP) solutions of bovine origin (Thrombinar, Jones Medical) promote hemostasis by catalyzing the conversion of fibrinogen to fibrin. They may be used in conjunction with fibrinogen concentrates prepared from autologous cryoprecipitate or from pooled donor blood.

2.8.3 Tissue sealants: Tissue sealants are absorbable and are used for a variety of indications including sealing of arterial punctures, sealing of air leaks during pulmonary surgery, and supporting wound healing. The area of tissue sealants is expanding rapidly, with new products reaching the market for numerous indications. Angio-seal (Kendall), an absorbable material, is used as a sealant for arterial punctures. AdvaSeal (Focal), a synthetic absorbable sealant, is used to seal air leaks during pulmonary surgery. Tissell (Immuno AE), a two-component fibrin sealant, is used to promote wound healing as well as achieve hemostasis and tissue adhesion. BioGlue, (Cryolife) is a bovine albumin- based glue used to seal aortic aneurysms and anastomotic sites.

2.8.4 Tissue glues: Tissue glues are used for topical skin adhesives and replace the need for sutures, staples, or adhesive strips for certain types of lacerations requiring closely approximated wound edges. Dermabond (Closure Medical), an octyl cyanoacrylate, is used as a topical skin adhesive that sloughs from the wound as re-epithelialization of the skin occurs, providing sufficient time for wound healing. Indermil (Tyco Healthcare), a butyl cyanoacrylate, is another topical skin adhesive.

2.8.5 Disposable sterile OR and OB packs: Disposable sterile OR and OB packs are prepared, packaged, and sterilized assemblies of diapering and gown units, designed to fulfill the operating and delivery room needs. They eliminate the problems of laundering, storage, assembly, and sterilization of muslin drapes and gowns. They introduce many special materials with particular properties of porosity; repellency to water, alcohol, blood and other fluids; abrasion resistance; and other desirable attributes.

2.8.6 Double packages: Double packages of contamination-resistant paper have been developed to permit opening and use without compromising sterility. Retention of sterile characteristics until used, eliminates the need for re-sterilization. Face masks for use in the operating room and where contamination must be controlled generally are made of plied, fine-mesh gauze, shaped to cover the nose, mouth, and chin. They are laundered and autoclaved. Disposable face masks with special filtration material giving high retention of particulate matter and designed for more effective fitting are available from several manufacturers. Surgine Face Mask (Johnson & Johnson) claims a 94% filtration efficiency with high user comfort.

2.9 Surgical dressings

2.9.1 Adhesive bandage: Adhesive Absorbent Compress; Adhesive Absorbent Gauze: A compress of four layers of Type I absorbent gauze, or other suitable material, affixed to a film or fabric coated with a pressure-sensitive adhesive substance. It is sterile. The compress may contain a suitable antimicrobial agent and may contain one or more suitable colors. The adhesive surface is protected by a suitable removable covering. Description-The compress is substantially free from loose threads or ravelings; the adhesive strip may be perforated, and the back may be coated with a water-repellent film.

2.9.2 Gauze bandage: Type I absorbent gauze; contains no dye or other additives. Description-One continuous piece, tightly rolled, in various widths and lengths and substantially free from loose threads and ravelings.

2.9.3 Oxidized cellulose: Absorbable Cellulose; Absorbable Cotton; Cellulosic Acid; Hemo-Pak (Johnson & Johnson); Oxycel (Deseret Medical) Sterile gauze or cotton that has been oxidized chemically to make it both hemostatic and absorbable; contains 16% to 24% carboxyl (COOH) groups. Description-In the form of gauze or lint. Is slightly off-white in color, is acid to the taste, and has a slight charred odor; Solubility-Insoluble in water or acids; soluble in dilute alkalies; Comments-The value of oxidized cellulose in various surgical procedures is based upon its properties of absorbability when buried in tissues and its remarkable hemostatic effect. Absorption occurs between the second- and seventh-day following implantation of the dry material, depending on the adequacy of the blood supplied to the area and the degree of chemical degradation of the implanted material. Complete absorption of large amounts of blood-soaked gauze may take 6 weeks or longer, and serious surgical complications and cyst formation have been reported as the result of failure to absorb. Hemostasis depends upon the marked affinity of cellulosic acid for hemoglobin. When exposed to blood, either in vitro or in surgical conditions, the oxidized gauze or cotton turns very dark brown or black and forms a soft gelatinous mass that readily molds itself to the contours of irregular surfaces and controls surgical hemorrhage by providing an artificially induced clot. Pressure should be exerted on the gauze or cotton for about 2 min to facilitate the sealing off of small, bleeding vessels.

Two factors require emphasis:

1) cellulosic acid does not enter the physiological clotting mechanism per se but forms what might be termed an artificial clot as described and, therefore, is effective in controlling the bleeding hemophiliac and
2) the hemostatic action of cellulosic acid is not enhanced by the addition of other hemostatic agents, such as thrombin (which in any case would be destroyed by the pH of the gauze unless some means of neutralization were practicable). The hemostatic effect of either one alone is greater than the combination. It is useful as a temporary packing for the control of capillary, venous, or small arterial hemorrhage, but since it inhibits epithelialization, it should be used only for the immediate control of hemorrhage and not as a surface dressing. A purer and more uniform product prepared from oxidized regenerated cellulose has been developed and is available as Surgicel Absorbable Hemostat. This offers many advantages over the older, less-uniform oxidized cellulose derived from cotton and, because of its chemical uniformity, ensures dependable performance and overcomes many of the difficulties encountered with the older type of cotton

product. The knitted fabric strips do not fragment, may be sutured in place easily if necessary, and provide prompt and complete absorption with minimum tissue reaction.

2.9.4 Oxidized regenerated cellulose: Surgicel; Surgicel Nu-Knit; Surgicel Fibrillar (Johnson & Johnson) Contains 18-24% carboxyl groups (COOH), calculated on the dried basis. It is sterile. Preparation-Cellulose is dissolved and regenerated by a process similar to the manufacture of rayon, which is then oxidized; Description-Creamy white gauze, lint, or woven material; Solubility-Insoluble in water; soluble in alkali hydroxides; Comments-Absorbable hemostatic.

2.9.5 Purified cotton: Gossypium Purificatum; Absorbent Cotton. The hair of the seed of cultivated varieties of Gossypium hirsutum Linné or other species of Gossypium (Fam Malvaceae), freed from adhering impurities, deprived of fatty matter, bleached, and sterilized in its final container. Description-White, soft, fine, filament-like hairs appearing under the microscope as hollow, flattened and twisted bands, striate and slightly thickened at the edges; practically odorless and practically tasteless; Solubility-Insoluble in ordinary solvents; soluble in ammoniated cupric oxide TS.

2.9.6 Dextranomer: Debrisan (Johnson & Johnson). Dextranomer is a three-dimensional cross-linked dextran polymer prepared by interaction of dextran with epichlorohydrin. Description-White, spherical beads, 0.1 to 0.3 mm in diameter; hydrophilic. Also available dispersed in polyethylene glycol, as a paste; Solubility-Insoluble in water or alcohol. Each gram absorbs about 4 ml of aqueous fluid, the beads swelling and forming a gel; Comments-Topically to cleanse secreting lesions such as venous stasis ulcers, decubitus ulcers, infected traumatic and surgical wounds, and infected burns. It absorbs the exudates, including the components that tend to impede tissue repair, and thereby retards eschar formation and keeps lesions soft and pliable.

2.9.7 Absorbable dusting powder: Starch-derivative Dusting Powder. An absorbable powder prepared by processing cornstarch and intended for use as a lubricant for surgical gloves; contains not more than 2% magnesium oxide. Description-White, odorless powder; pH (1 in 10 suspension) between 10 and 10.8.

2.9.8 Absorbent gauze: Carbasus Absorbens; Gauze. Cotton, or a mixture of cotton and not more than 53.0%, by weight, of purified rayon, in the form of a plain-woven cloth. If rendered sterile, it is packaged to protect it from contamination. Description-White cotton cloth of various thread counts and weights; may be supplied in various lengths and widths and in the form of rolls or folds.

2.9.9 Purified rayon: A fibrous form of bleached, regenerated cellulose. It may contain no more than 1.25% titanium dioxide. Preparation-By the viscose rayon process; Description-White, lustrous or dull, fine, soft, filamentous fibers, appearing under the microscope as round, oval, or slightly flattened translucent rods, straight or crimped, striate and with serrate cross-sectional edges; practically odorless and practically tasteless; Solubility-Very

soluble in ammoniated cupric oxide TS or dilute H2SO4 (3 in 5); insoluble in ordinary solvents; Comments-Hemostatic.

2.9.10 Adhesive tape: Sterile Adhesive Tape. Fabric and/or film evenly coated on one side with a pressure-sensitive, adhesive mixture. If rendered sterile, it is protected from contamination by appropriate packaging.

3. Conclusion

Wounds will readily acquire bacteria, unless protective measures are taken. The bacterial protection afforded by conventional absorbent cellulose dressings has been shown to be limited, particularly in the presence of serous exudate that may compromise dressing integrity. In addition, dressings may shed particles that remain in the wound. By contrast, many modern dressings are impermeable to bacteria, are removed completely, have been found to optimize re-epithelialization rates and reduce the incidence of wound sepsis. Recently, it has been found that they could also play a role in preventing cross-contamination. Removing conventional cellulosic dressings from bacterially colonized wounds liberates wound bacteria into the air, and the numbers are slow to decline. However, using an in vitro wound model, use of the hydrocolloid dressing on experimentally colonized wounds resulted in significantly fewer numbers of airborne bacteria. Dispersal from wet conventional dressings was lower than from dry dressings; nevertheless, the numbers of bacteria per liter of air following removal of the hydrocolloid dressing were approximately 20% of those observed for gauze. These findings have also been confirmed in the clinic. To reduce the incidence of complications, wound care in general, and infection control procedures in particular, requires carefully disciplined team work.

Acknowledgement

It's a great gratitude and honor to be a part of healthcare research and education. Pharmacists of all disciplines and other professionals that I have conducted was very much helpful in discussing healthcare situations in Bangladesh, providing books, journals, newsletters and precious time. The greatest help was from my students who paid interest in my topic as class lecture and encouraged to write such article on surgical enrichment. Despite a great scarcity of funding this purpose from any authority, the experience was good enough to carry on research.

Compliance with the Ethical Issues: Ethics approval and consent to participate

Animal and human experiment: N/A

Human data submission approval: N/A

Consent for Publication

Consent to publish Individual Person's data: N/A

Availability of Data and Materials

Data sharing: Please contact author for data requests

Competing Interests

The authors declare that they have no competing interests

Funding

Funding from individual/Organization: N/A

Authors' Contributions

The individual contributions of authors: N/A

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Citation: Mohiuddin AK. A Thoroughgoing Detail of Surgical Dressings. Journal of Orthopaedics and Sports Medicine 1 (2019): 001-017.