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Popular Article

High Performance Textiles for Wound Care

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What is wound?

- An injury to living tissue caused by a cut, blow, or other impact, typically one in which the skin is cut or broken.
- Any break in external or internal surface of the body involving a separation of tissue.

Wound Healing Process:

- Acute wounds (Take few weeks to heal)
- Chronic wounds (Take several months to heal)

Classification Based on Depths of Wound

- Superficial wounds (involves only the epidermis)
- Partial thickness wounds (involves epidermis and dermis)
- Subcutaneous wounds (involves subcutaneous fat deeper tissues)

Types of Wound Dressings:

- Primary dressing is covered by secondary dressing. The primary dressing is expected to maintain the wound temperature and moisture level to permit respiration and allow epithelial migration.

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- Secondary dressing must not be too absorbent. It placed over outer area for further protection, infection, compression and occlusion.

Characteristics of the ideal dressing

- Capable of maintaining a high humidity at the wound site while removing excess exudate.
- Non-toxic and non-allergenic
- Capable of protecting the wound from further trauma
- Can be removed without causing trauma to the wound
- Will allow gaseous exchange
- Comfortable and cost effective
- Long shelf life

Table: Commercial Wound dressing

Commercial Name	Major Application
Low-adherent dressing	Reduces risk of adherence to wounds, Less trauma
Semi-permeable dressing	Lightly exuding wounds, superficial pressure sores.
Odour adsorbing dressing	Undesirable odor producing wounds.
Hydrogel dressing	Dry and necrotic wounds and light exuding wounds, not suitable for heavily exuding wounds.
Polyurethane foam dressing	Light to medium wounds. It is not recommended for dry superficial wounds.
Alginate dressing	Medium to heavily exuding wounds. Not suitable for dry wounds
Alginate-Collagen dressing	Suitable for foot ulcers and heel pressure sore.

Types of wound dressings

- **Occlusive dressing:** retain wound fluids that contain growth factors, enzymes and immune cells which helps to accelerate wound healing.
- **Non occlusive** are the dry dressings, use on donor and recipient sites, first and second degree of burn and abrasion surfaces.

Hydrocolloid dressings

- Produce a warm and damp environment by liquefying and swelling.
- Provide a barrier to microorganism.
- Help to reduce pain by keeping surrounding nerve endings moist.

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Low adherent dressings

- Suitable for use on flat, shallow wounds.
- It allows exudates to pass through into a secondary dressing while maintaining a moist wound bed.
- It is open weave cloth soaked in soft paraffin or chlorohexidine, multilayered or perforated plastic films.
- It reduces adherence at the wound bed and are particularly useful for patients with sensitive or fragile skin.

Alginate dressings

- Made from seaweed.
- Exchange in sodium ions with calcium ions creates a fibrous gel.
- Which helps to provide a moist and warm wound environment?
- Mainly used for diabetic foot ulcer.
- Collagen-alginate is also used for management of foot ulcers.
- Calcic-sodium alginate is used for the treatment of pressure, bleeding and infected vascular ulcers.
- Used for moderate types of wounds.
- Lyocell fibre dressing can replace the alginate dressing for the treatment of chronic wounds.
- Lyocell is chemically converted to produce a new fibre, hydrocel, using carboxymethyl cellulose.
- Wound dressing comprising a chitin and expandable poly-tetra-fluoro-ethylene (PTFE) layer.

Odour adsorbent wound dressings: Wound malodorus is increasingly becoming a major problem.

- Patients often find the odour too embarrassing to socialize.
- Wound mlodour generally affects chronic wound types such as venous leg ulcer, fungating lesions (malignant cancerous), diabetes foot ulcers and pressure ulcers.
- The malodour is presence of devitalised, necrotic tisuue or the severe infection of bacterial microorganisms.
- If the wound odour is due to necrotic tissue, debridement can drastically reduce the malodour, If due to severe infection then it could be due to aerobic and anaerobic bacteria.

Malodour Treatment

- Debridement to remove necrotic/dead tissue.
- A short dose of an antibiotic treatment.
- Specialist odour adsorbent dressing.
- Currently all the odour adsorbent dressing contains a layer of highly adsorbent ACC.

ACC: Activated Charcoal Cloth

- ACC dressings are composed of many different materials, ranging from the traditional naturally adsorbent fibre types such as:Cotton and Viscose.
- Specialist materials such as: Polyurethane film. and fibes such as: Alginate and carboxymethylcellulose fibres (CMC).
- Now a days all the odour adsorbing dressings having layer of ACC. These dressings can split into two categories: Fluid up-take/ absorbent and Non absorbent

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- The absorbent dressings are generally composed of multilayer composites with layers of highly adsorbent fibrous or fleece with ACC.
- Some many contains alginate and CMC fibres as wound contact layer.These dressings are relatively expensive as compared to others dressings.

Table: Commercial odour adsorbent dressings

Dressing	**Manufacturer**	**Main Components (ACC – activated charcoal cloth)**
Carboflex	ConvaTec	ACC, absorbent multilayer with an alginate and CMC fibrous wound contact layer.
Lyofoam C	Medlock	ACC, polyurethane foam
Carbonet	Smith & Nephew	ACC, absorbent multilayer laminate with a 100% viscose warp-knitted wound contact layer with claimed low adhesion.
Sorbsan plus carbon	Pharma-plast Ltd.	ACC, absorbent multilayer laminate with an alginate fibrous wound contact layer.
Actisorb silver 220	Johnson & Johnson	ACC, with silver, non-woven polyamide
Carbopad VC	Vernon Carus	ACC, non-woven polyamide
Clinisorb	CliniMed Ltd.	ACC, non-woven polyamide laminate
(Std) Melolin	Smith & Nephew	Absorbent cotton and polyester fibrous fleece with a perforated film contact layer

Antimicrobial Wound Dressings

- Antimicrobial dressings prevent the wound from bacterial invasion.
- Commercially synthetic wound dressing is available i.e., Polyurethane.
- Polyurethane membrane minimizing the evaporation from the wound.
- The dressings have two layers: Outer membrane prevents body fluid loss, controls water evaporation and protect the wound from bacteria. Inner membrane/matrix encourages wound adherence by tissue growth into the matrix. *(Silver/nano-silver is incorporated in the wound dressings which provides an antimicrobial shield against a wide range of bacteria).*

Compression Bandages

- Venous leg ulcer are most common type of ulcers and their prevalence increase with the age.
- Mostly the elderly persons are prone to develop DVT (Deep Vein Thrombosis), varicose veins and venous leg ulcer are most frequently type of chronic wound.
- The compression bandages mainly enhance the flow of blood back to the heart, improves the functioning of valves and calf muscle, reduce oedema and prevents the swelling of veins.

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Table Elastic bandage classification

Class	Bandage type	Bandage Function
1	Light weight conforming	Apply low level of sub-bandage pressure and is used to hold dressing in place.
2	Light support	Apply moderate sub-bandage pressure and is used to prevent oedema and ulcers.
3a	Light compression	Exert a pressure range of 14-17 mmHg
3b	Moderate compression	Exert a pressure range of18-24 mmHg
3c	High compression	Exert a pressure range of 25-35mmHg
3d	Extra high compression	Exert a pressure up to 60mmHg

Non-Elastic Compression Bandage

- A plaster type non elastic bandage, **Unna's Boot** in USA. Unna's Boot provides a high working pressure when the calf muscle contract, but very little pressure while the patient is at rest. The high working pressure serves to increase the blood flow, while the resting pressure facilitates deep venous filling. The Unna's Boot is only effective in ambulatory patients and require constant re-application. Unna's Boot is rigid, uncomfortable to wear and medical professionals are unable to monitor the ulcer after the boot is applied. Unna's Boot is very expensive and also difficult to apply. Unna's Boot consists of 100% high twisted cotton yarns and are applied onto the limb at full extension.

The salient features of the developed bandages are

- Suitable bulkiness.
- Tensile strength or breaking extension should be adequate.
- Tear resistant of bandages is high.
- Absorption of solution containing Na^{+} and Ca^{++} ions (artificial blood) is high.
- Rate of absorption of all the developed bandages is also high.
- Pressure distribution of all the novel bandages is good up to 60mm Hg.

Three-Dimensional Spacer Fabric

- The spacer technology is flexible, versatile, cost effective and an ideal route to produce 3D materials for medical use. In 3D spacer fabric, for producing compression bandages. Two separate fabric layers are combined with an inner spacer yarn or yarns using either warp or weft knitting.

- The two layers can be produced from different fibre types such as: *polyester, polypropylene, cotton, viscose, lyocell, wool etc can be completely different structure*. It is also possible to

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produce low modulus spacer fabrics by making use of elastic yarns. Elastic compression could be achieved by altering the fabric structure. 3D structure allows greater control over elasticity and these structures can be engineered to be uni-directional, bi-directional and multi-directional. Unidirectional elasticity is one of the desired properties for compression bandages. The main advantages of weft knitted spacer fabrics over warp knitted fabrics include cost effectiveness. Because there is no need to prepare a number of warp beams and spun yarns as well as coarser count hairy yarns can be used on weft knitting machines.

Conclusion

Medical textiles are one of the dynamically expanding sectors & development of same is to convert painful days of patients into comfortable days. As medical procedures continue and transform, the demand for textile materials is bound to grow and grow. To get correct, hygienic/medical textile products we should put our concentration to develop new technologies as well as put concentration on the price of the products.

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