

A Brief Review Research on Use of Textile in Medical Science

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Abstract: Medical textile is combination resultant of technology and textile in medical area. Textile materials are used for healthcare and hygiene products like gauze or bandage. The textile materials are having some specific properties which is to be very useful in medical sector Textile based materials that are used in medical applications like fibers, yarns, fabrics and composites. These materials are depending upon the application, the requirements of textile for medical applications. Medical textile products are biocompatible, having good resistance to acids and alkalies, micro-organisms. They also having properties like good dimensional stability, very good in absorption, air permeability.

Keywords: Medical textile, bandage, biocompatible, micro-organisms, air permeability, healthcare and hygiene.

1. General Introduction

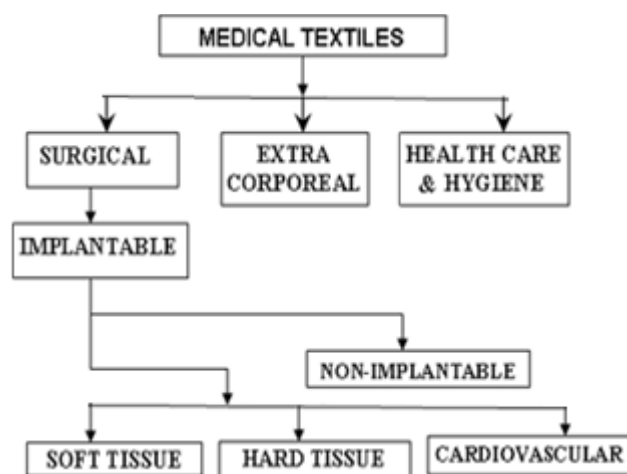
- **Definition of Medical System:** Medical system is defined as a health system or health care system in which people resources and groups are provided health care services to the target population.
- **Definition of Textile:** Textile is a composition of natural and synthetic fibers which are used for the production of clothing materials.

2. What is Medical Textile

The textile materials are having some specific properties which is to be very important in using medical system. Some of textile materials are highly used in medical applications together with fibers, yarns, fabrics and their composites. "Depending upon the application and the requirements of textile material for medical applications are: Biocompatible; Good resistance to alkalis, acids and micro-organisms; Good dimensional stability; Elasticity Free from contamination or impurities; Absorption / Repellency; Air permeability".

Medical textile means textile products used for the medical purposes. Textile is a very important part of human life since a very long time. The term medical textile is created newly. For the medical purposes textile material have a very various range of properties that are flexibility, absorbency, strength, elasticity, non-toxic, flame retardant, non-allergic, and non-irritant dyes are used in the medical products. Medical textile is also known as health care and hygiene textile and it is one of branch of technical textile. Medical textile is categorized as:

- Non-Implantable Materials** – wound dressings, plasters, bandages etc.
- Extra Corporeal Devices** – artificial kidney, liver and lungs.
- Implantable Material**- sutures, vascular graft, artificial joints etc.
- Health Care and Hygiene Products** - bedding, clothing, surgical gown, wipes etc.



*Source of Image: technicaltextile.net

^[1] "From a scientific point of view, medical textiles are located at the interfaces between technical disciplines and life sciences. On the one hand, the technical aspect concerns textile engineering, material chemistry, process control, testing and certification, etc., which are needed for the manufacture of high-quality medical textile products. On the other hand, life sciences such as medicine, microbiology, and other related subjects are required for the development of functional performances of these products. In practice, the different scientific and technical disciplines interact and overlap with one another, with new developments in any one of these branches able to generate new innovations in others".

3. Non-Implantable Medical Textiles

3.1 What is wound?

Wound is discontinuity; break in epithelium tissue of the skin. Skin has the largest area of the body where the wounds occur: by infections like bacterial, fungal, virus. It is a breach in the continuity of skin or tissue caused by an accident, act of violence or surgery. Wound healing is that body mechanism which easily repairs the entire injured parts. It is a loss of continuity of skin due to injury mainly soft tissues are damaged during injury. It is simple when

only skin is involved; it is complex when it involves underlying nerves, vessels, and tendons etc.

Wound care products are comes under non – implantable materials such as absorbent pads, bandages and plasters. These are used for external application. Wound dressings are that usually made from the highly absorbent fibers or polymer coatings which absorb high blood and provide good medication some are supplementary finishing materials and compositions that becomes an essential part of the product. [2] “Wound dressings generally consist of a layer of absorbent material, such as an absorbent gauze or foam layer, wherein the layer is supported on an adhesive coated semi-permeable backing sheet. An adhesive-coated margin of the backing sheet extends outwardly from the edges of the absorbent layer for attachment of the dressing over a wound by adhesion to the skin surrounding the wound. The absorbent layer serves to absorb wound exudates”.

3.2 Implantable Medical Textiles

Textile materials are soft very flexible, and strong in nature although they are similar to the physical and mechanical properties of within the human body structures. [3] “Textile fibers, yarns, fabric and composites and 3-D shaped fabrics from woven, knitted, nonwoven, braided and embroidery play a vital role in the manufacture of various implants, including the replacement of diseased or non-functioning blood vessels and segments of aorta or other big arteries. It is even feasible to produce vascular prosthesis as fine as 2-3mm in diameter. These materials are used in effecting repair to the body whether it is wound closure (sutures) or replacement surgery (vascular grafts, artificial ligaments etc). By careful control of the polymer and fiber structures and also by appropriate surface treatment, textile-based materials can be engineered into two- or three-dimensional structures that can be used as artificial ligaments, hernia meshes, vascular prostheses, and many other novel implants”.

Hygiene and Healthcare Medical Textiles	Non-Implantable Medical Textiles	Implantable Medical Textiles	Extracorporeal Medical Textiles
<ol style="list-style-type: none"> 1. Surgical gown/drapes 2. Surgical facemasks 3. Beddings, blankets, sheets, pillow covers. 4. Feminine hygiene products 5. Wet wipes 6. Adult incontinence diapers 7. Underpads 	<ol style="list-style-type: none"> 1. Compression stockings 2. Wound dressings 3. Waddings 4. Tubular bandages 5. Gauze 6. Pressure garments 	<ol style="list-style-type: none"> 1. Vascular grafts 2. Abdominal wall patches/meshes 3. Sutures 4. Heart patches/valves 5. Stents: pet monofilament 6. Tendon/ligament reinforcements 7. Dura patches (Non-woven) 8. Artificial veins 9. Artificial joints and bones 10. Artificial skin and artificial cartilage 	<ol style="list-style-type: none"> 1. Hemodialysis 2. Artificial liver 3. Extracorporeal membrane oxygenation 4. Artificial heart 5. HME filter 6. Leukodepletion filter

*source of Image : Google Images

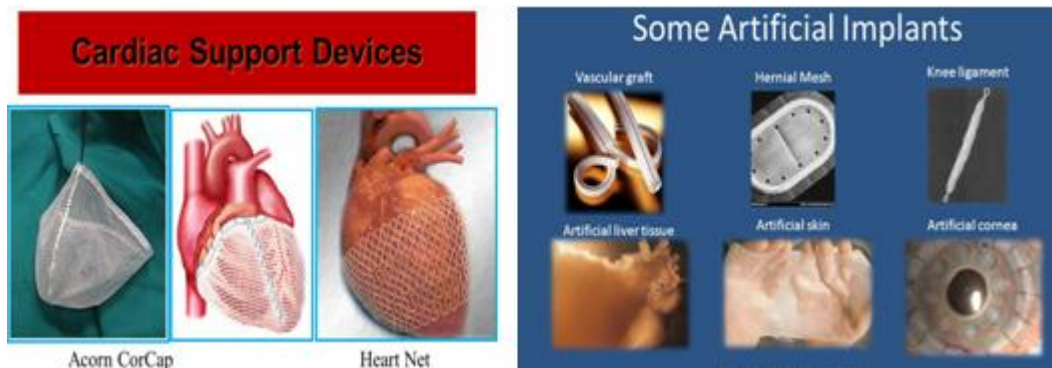
	Product Name		Fiber type	Fabric type	Function
Implantable Materials	Sutures	Biodegradable	Collagen, Lactide, Polyglycolide	Monofilament, braided	used to hold body tissues together after an injury or surgery
		Nonbiodegradable	Polyamide, Polyester, PTFE, Polypropylene, Silk	Monofilament, polyglycolide braided	Used to hold body tissues together after an injury or surgery
	Soft Tissue Implants	Artificial tendon	PTFE, polyester, polyamide, silk, polyethylene	Woven, braided	Used in Achilles tendon repair with studies on equine subjects.
		Artificial ligament	Polyester, carbon	Braided Nonwoven	An artificial ligament is a reinforcing material that is used to replace a torn ligament
		Artificial cartilage	Low-density polyethylene		To mimic the functional properties of natural cartilage in the human body.
		Artificial skin	Chitin		
	Artificial cornea	Polymethyl methacrylate, corneasilicone, collagen		The device is a huge step forward for people with corneal blindness who have rejected human tissue.	
	Orthopedic implants	Artificial bones/joints	Silicone, polyacetal, Polyethylene		used in bone grafts
	Cardiovascular implants	Vascular grafts	Polyester, PTFE	Knitted, woven	Used to make a path to flow blood one area to another
		Heart valves	Polyester	Woven, knitted	Implanted in the heart of a patient with the valvular heart disease.
Wound care	Absorbent Pad	Cotton, Viscose	Nonwoven	The functions of these materials are to provide protection against infection, absorb blood and exudate, promote healing	
Non-implantable Materials	Bandages	Wound contact layer	Silk, polyamide, viscose, Polyethylene	Knitted, woven, nonwoven	To hold Dressings in place over wounds.
		Simple inelastic/elastic	Cotton, viscose, elastomeric yarns	polyamide, Woven, knitted, nonwoven	
		Light support	Cotton, viscose, elastomeric	Woven, knitted, nonwoven yarns	
		Compression	Cotton, polyamide, elastomeric yarns	Woven, knitted	
	Orthopadic	Cotton, viscose, polyester polypropylene, polyurethane foam	Woven, nonwoven		
	Plasters		Viscose, plastic film, cotton polyester, glass, polypropylene	Knitted, woven, nonwoven	Protects the wound and scab from friction, bacteria, damage, and dirt.
	Gauzes		Cotton, viscose	Woven, nonwoven	It is especially useful for dressing wounds where other fabrics might stick to the burn or laceration
	Lint		Cotton	Woven	
	Wadding		Viscose, cotton linters, wood pulp	Nonwoven	
Extracorporeal devices	Artificial kidney		Hollow viscose, hollow		Remove waste products from patients polyester
	Artificial Liver		Hollow viscose		Separate and dispose of patients plasma, and supply fresh plasma
	Mechanical lung		Hollow polypropylene,		Remove carbon dioxide from patients hollow silicone, and supply fresh blood membrane
	Surgical clothing	Gowns	Cotton, polyester, Polypropylene	Nonwoven, woven	
		Caps	Viscose	Nonwoven	
		Masks	Viscose, polyester, glass	Nonwoven	
	Surgical covers	Drapes	Polyester, polyethylene	Nonwoven, woven	
		Cloths	Polyester, polyethylene	Nonwoven, woven	
	Bedding	Blankets	Cotton, polyester	Woven, knitted	
		Sheets	Cotton	Woven	
Pillowcases		Cotton	Woven		
Healthcare/hygiene products	Clothing	Uniforms	Cotton, polyester	Woven	
		Protective Clothing	Polyester, polypropylene	Nonwoven	
	Incontinence diaper/sheet	Cover stock	Polyester, polypropylene	Nonwoven	
		Absorbent layer	Wood fluff Superabsorbent	Nonwoven	

*source of Image: Medical Textiles: Application of Implantable Medical Textiles Medical Textiles By Shah Md. Maruf Hasan, Md. Shahjalal, Jaglul Hoque Mridha & A. M. Riasat Alam Northern University. Global Journal of Medical Research: K Interdisciplinary Volume 19 Issue 4 Version 1.0 Year 2019, Peer Reviewed International Research Journal Publisher: Global Journals Online ISSN: 2249-4618 & Print ISSN: 0975-5888

3.3 Extra Corporeal Devices

Extracorporeal fibers are those which are used in the mechanical organs such as artificial kidney, artificial liver and mechanical lung. Use of an artificial organ is a life saving treatment which can re-establish and restore the mechanism that does not function, and it provides a active balance that can be obtained by organ transplantation to recover health again. The function of artificial kidney is to get circulating blood through a membrane, which can also be in the form of cellophane that hold the unwanted waste

materials. Multilayer fibers are composed with several layers of needle-punched fabrics that are having in different densities which may also be used and designed to remove the waste materials quickly . [4]“Mechanical lungs use microporous membranes that provide high permeability for gases (both O2 and CO2) but low permeability for liquid flow and functions in the same manner as the natural lung allowing oxygen to come into contact with the patient's blood. During the flow, oxygen, which is maintained at a high partial pressure, displaces carbon dioxide, thus effecting purification”.



*source of Image: Google Images

3.4 Health Care and Hygiene Products

It is a very essential area of textile where is the healthcare and hygiene sector from other medical applications and sector. The wide range of products are available for healthcare and hygiene they are usually used either in the operating theatre or in the hospital wards for hygienic and care purpose, and safety of the staff and patients. They might be available in the option washable or disposable.



4. Review Studies on Medical Textiles

Prof. Laga S.K and Darne Apurva 2013, the aim of this article to describe that the wound healing depends on proper medication and also on proper dressing, variation of dressing material depends on type of wound and wound management.

Bhargava Deepti and Jahan Shahnaz 2012, expressed views on textile based dressing. Chosen of the material for wound according to the absorbency, elasticity, comfort ability, durability etc. Following these are the properties of textile material which are seen in dressing material of wound. Wound dressing promotes the wound healing. Dressing on wound is to prevent or protect the wounded area from the external application. "The key qualities of fibers and dressings as wound care products include that they are bacteriostatic, anti-viral, fungi static, non-toxic, high absorbent, non-allergic, breathable, haemostatic, biocompatible, and can be manipulative to incorporate medications, also provide reasonable mechanical properties". Hence textile based material or product is very useful for wound dressing either in surgical wound or non-surgical wound, the variety of material totally depends on type of wound and the depth of wound.

Ajmeri R. Jitendra, Ajmeri Chitra and Joshi N. B., described about the textile material and products that have been skillfully managed for particular and suitable needs for medical and surgical applications. During the management of products there are some points which are to be kept in mind are absorbency, strength, air permeability, durability, elasticity of textile based product for wound management.

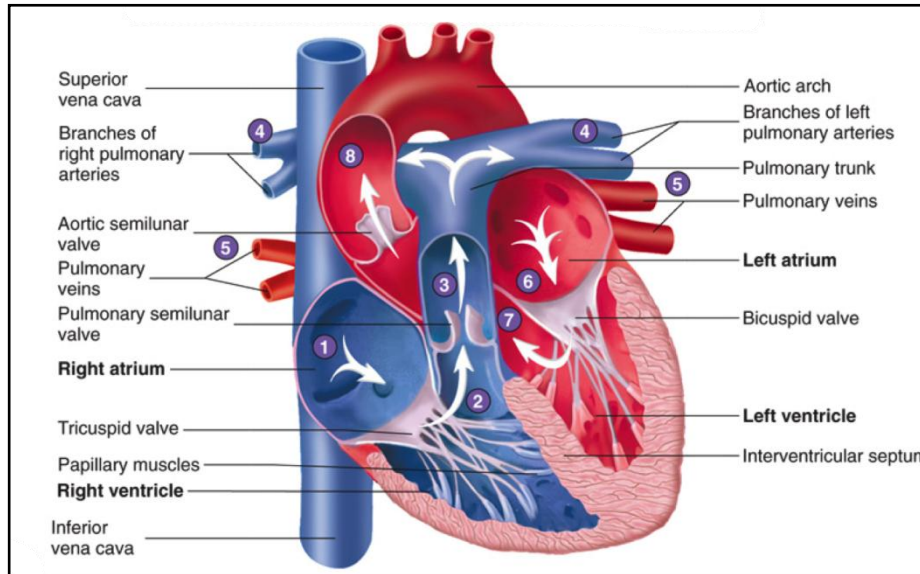
Abhishek, 2012, research paper describes the protection of patients from infection. In the field of medical science there are so many textile based products used like bandage, cotton gauze, stitch thread (use to close wound) etc. And in the area of surgery woven and non-woven textile based products are used to control infections from microorganisms "Nonwovens used to control the barriers in the surgical environment. They protect from fluid particulate and microorganisms to reduce the chance of cross infections", generally in the surgical operations there is a significant reduction in the post-operative infection rate when the disposable products are used. It also reduces the chance of wound infection. "They are usually used in the composite form, they are sterile, soft, antibacterial and water and other liquid repellent as well as absorbent. For the end use of surgical other area of medical nonwoven can be wood pulp and also from manmade fiber such as nylon, polypropylene, polyester, polyethylene, glass and polytetrafluoroethylene (PTFE) etc. Non-woven plays an important role in the field of hospitals".

5. Role of Textile in Cardiology

Cardiovascular system in which blood flows in one direction only. The system set in the central part of human body called as heart and it is made up of three different types of blood vessels known as arteries, veins and capillaries. The cardiovascular system have two main circulatory systems that known as arterial system and venous system both system based on the circulation of blood to heart. The venous system helps in common blood circulation which is to send oxygen reduced blood rich in cell metabolism waste to heart. The venous return in the direction of the heart depends on venous pressure that is developed in the veins, the accurate returning of blood in normal venous system which includes perforatory veins, deep veins superficial veins and complex network of veins. Deep and superficial veins are related with perforatory veins. In normal condition the heart pumps pure blood which transfers oxygen and nutrients to arteries, once the blood flows from arteries into the capillaries with necessary nutrients of pure blood which transfers to

tissues and blood cells and replace impure blood containing waste products, carbon dioxide, water and urea The venous

or impure blood delivered to deep veins after passing capillaries and push it back to heart.



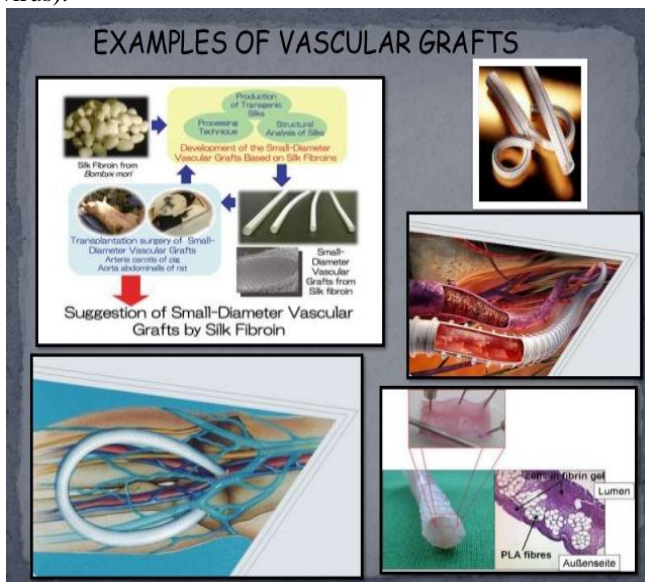
*source of image : www.nlm.nih.gov,

Role of Alternative Medical system (Homeopathy) for the Development of product which will in the remedy of Varicose Vein Ulcer By : Ankita Singh Rao

Artificial veins and arteries used to replace in the segment of natural cardiovascular system that are blocked or weakened. Textile based vascular grafts are: Polyester grafts, Dacron graft, polytetrafluoroethylene grafts . They are biocompatible, flexible and durable in nature. They have good stability to sterilize and good resistance to antibodies (bacteria and virus).

6. Conclusion

Medical textile is one of the most important area of emerging technical textiles sector with the wide range of applications in development of new products . Such as to formulate and construct artificial organs with functioning, use of microporous hollow fibers made up of polyester, viscose, polypropylene, silicone, etc. Textiles are now more and more developing into interdisciplinary areas with high-tech products interesting to changes the market.



*source of image: Google images

[5] “A major requirement for the use of the method is that the heart valve prosthesis is flexible enough to be folded into the lumen of a small diameter catheter. A standard material used for the construction of arterial grafts and which could also be suitable for engineering heart valve prosthesis is polyester textile fabric. Textile valves are alternatively, can be designed with durability and to exhibit hemodynamic similar to the native valve, lowering the risk for thrombosis”.

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