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A STUDY ON THE TEXTILE MATERIALS APPLIED IN HUMAN MEDICAL TREATMENT

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Abstract:
The aim of this paper is to discuss about the textile materials those are used in human medical treatments. The findings of this paper established that some textile materials are also used in physiotherapy and rehabilitation treatments. Natural and synthetic materials are used to prepare health care hygiene products. Bandage gauges, plaster, wound dressing products are known as non-implantable medical textile products those are prepared from textile fibers. Some therapeutic products are also prepared from textile materials. Sutures and ligaments, vascular grafts, artificial skin, artificial cornea, contact lenses, and dental biomaterials are implantable products those are also prepared from textiles. Extra corporal devices like artificial hearts, livers, lungs, kidney are also prepared from textile materials. A lot of sanitary and hygiene products are also prepared from textile materials. Surgical masks, drapes and clothes, surgical gowns, surgical caps, gloves, baby diapers, and sanitary napkins are directly produced from textile materials. The findings of this paper are beneficial to the experts, scholars, and researchers who are involved in medical textiles studies. This paper opens possible ways for scholars to further study in this field.

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1. Introduction

Medical Textiles is one of the topics of technical textiles. A new field of textile technology, such as textile and medical sciences, which is currently known as medical textiles. Medical textiles are the most essential and growing part of the technical textiles, also known as Healthcare Textiles. Medical Textiles is one of the fastest-growing sectors in the technical textiles market [1]. It is one of the main growth areas in the technical textile sector and the use of textile materials for medical and health products ranges from simple gauze or bandages to scaffolding for the cultivation of fabrics. And a wide range of prostheses for everlasting body implants. These are used for first aid, medical or sterile purposes, and for rehabilitation [2]. Its use is based on a series of typical basic textile properties such as softness and lightness, flexibility, absorption, filtering, etc.

Textile use nowadays is not limited to just one subject. Its application is increasing day by day. As we use this textile to share us in our daily lives. But in medical science, today we will discuss the use of textiles in this medical discipline [3]. The use of textiles in medical fields is not started today. Its history can be traced back to the history of the old days. Sumerian civilization mentions this in the medical Scriptures in the year 25 BC. It is known that they used it to make various bands, plaster [4].

Advanced medical textiles are developing an important area due to their vast expansion in fields such as wound healing and controlled release, bandages and pressure clothing, implantable devices, and medical devices, and the development of new smart textile products. The current society is changing with the size of a large population, the need for increasing the standard of living of every human being, the various conditions of human activity, and the dangers, transport accidents, chemicals, fire, cold, disease, and sports are changing [5]. Such factors increase the demand for medical textiles. So, there are several research articles around the world on medical textiles and polymers.

Not all textile fibers can be used here, because their performance depends on the interaction with the cells and the different fluids produced by the body. Textile materials used in medical applications include fibers, threads, fabrics, and composite materials [6]. Depending on the application, the requirements of the textile material for medical applications are biocompatible; microorganisms; Good dimensional stability; Elasticity Free of contamination or impurities; Absorption/ repellency; Air permeability. Medical Textile Requires that it must be non-toxic like it does not contain any toxic material. It should be chemically inactive [7]. It must have durability, flexibility, and the ability to withstand any injury or force. It must have moisture absorption capacity. Medical substances should have good immunity to substances like alkali, acid, micro-organism. The fibers used in medical textiles- Natural fiber (cotton or cotton, silk fiber, etc.) and Synthetic fibers (Poly-ester, viscose, polyamide, polypropylene, carbon, glass) [8].

Clothing made from nano-fiber is widely used in the medical sector nowadays. As a result, the application of technical textiles in medical disciplines is being widely used. Nanotechnology has gained tremendous momentum in the past decade. The nano-fiber products and nano-coated materials are the current innovations in the medical field. So, in our technical poster, we looked at the latest medical textiles, nano-based products due to the following features and a wide range of applications [9]. Nanofibers are very attracted to their unique properties, from the high surface to the volume, from the thinness of the film, from the diameter of the fiber on the nanoscale, from the porosity of the structure, from the lighter weight. Nanofibers are porous and the pore size distribution could be wide-ranging, therefore scaffolds designed with a wide application in the field of tissue engineering can be considered. Some other applications such as to make wound dressing, plaster, bandage, gauze, etc. [10].

Depending on the use, medical textiles are classified as health and hygiene products, extracorporeal devices, implantable materials, and non-implantable materials. The use of textile materials for medical and healthcare products in the production of artificial ligaments, artificial kidneys, artificial liver, artificial lungs, etc. To make Operating gowns, operating dresses, sterilization packs, dressings, sutures, and restorative pads, nonwoven gowns, medical gloves, gowns, masks, baby diapers, sanitary napkins, surgical caps, plaster vascular grafts/heart valves, artificial joints/bones, eye contact lenses and artificial corneas and others are some examples of medical textile.

Consumption of medical tissues worldwide was 1.5 million tons in 2000 and is growing at an annual rate of 4.6%. The size of the Indian medical textile market was estimated at 14.8 billion Indian Rupee (INR) in 2003-04 and is expected to grow to 23.3 billion INR in 2007-08. The market is expected to grow by 8% per year [11].

2. Materials used in Medical Treatment

The textile materials those are applied in medical treatments can be subdivided into four categories such as non-implantable (e.g. dressing, bandages, gauze), implantable (e.g. artificial arteries, sutures, vascular grafts), extracorporeal devices (e.g. artificial organs), and sanitary and hygienic products [13].

2.1 Non-Implantable Medical Textiles

Implantable medical tissues are used for external body applications, which means that those used outside the human body to aid wound recovery are called non-implantable medical tissues. Non-implantable products are generally used to provide protection against infections, absorb blood and exudates, and promote healing. The term non-implantable is generally used to indicate surface wound treatments for different parts of the human body [14].

2.1.1 Physiotherapy

Prevention of heat loss, thermal insulation, and heat treatment play an important role in physiotherapy. For example, peripheral vascular diseases associated with metabolic diseases (e.g. Diabetes, arteriosclerosis), arthritis, paresis, and paralysis of peripheral nerves require interventions that involve heat therapy. Wool products such as clothing lines, braces, kneepads, and wooden pads have a very positive effect on the circulatory disorders mentioned above [15]. Furthermore, thanks to their unique physical and chemical properties, knitwear increases the pain threshold and reduces muscle tension; Knitwear can be worn both before and after exercise to prolong the therapeutic effect [16]. Physiotherapy sessions for children on wool mattresses also evoke additional sensory impulses, thus improving the sensorimotor results. The extension of the effect of heat on the skin following physical procedures such as massages, thermal therapies, and ultrasounds is considered one of the main therapeutic advantages [17]. There are also some easily obvious financial benefits. In addition, the influence of wool bedding on sleep patterns (associated with heat insulation and thermoregulation), as well as its regenerative effects in patients with somatic diseases and depressive disorders, will be discussed. Figure 1 shows a vibrating kneepad which uses for physiotherapy.

Figure 1: Vibrating kneepad for physiotherapy [18]

2.1.2 Rehabilitation

Tissues play an important role in products used in medical rehabilitation, particularly in areas such as compression therapy and orthopedics. The programmed pressure in shaped and designed products that guarantee a specific and constant unit pressure in a selected part of the body, contributes to the improvement of motor and sensory functions in children with congenital malformations, improvement of health (varicose veins), effects on the health of the treatment. accidents (burns, injuries) or injuries (for example, wrist joint) [19]. The knitted fabrics used in the orthopedic elements increase the comfort of the patient with lighter joint injuries, ensuring an improvement in the condition of their skin (protection against abrasions, ventilation, moisture absorption). These features are also provided for the prevention and treatment of pressure ulcers using spatial mesh forms to improve well-being and health, particularly for immobilized patients [20]. In addition to well-developed textronic solutions that are used to monitor the patient's vital parameters, in rehabilitation, textile devices are used to improve the movements and functions of the hands and arms by using different solutions based on the structure of the glove or through muscle stimulation therapies. Figure 2 shows about rehabilitation.

Figure 2: Rehabilitation time [21]

2.1.3 Wound Dressing

Wound dressings are used in the medical field to provide critical functions that have the collective goal of promoting wound healing. These functions are protection, absorption, compression, immobilization, and aesthetics. Protection is the primary function of the dressing, as exposed wounds can suffer additional trauma and additional tissue loss caused by external forces (e.g. harsh environments, objects in contact, or direct interaction). The wound dressing acts as a barrier against these forces [22]. Wound dressings generally consist of three components such as Contact layer, Absorbent pad, and Basic material. A modern dressing consists of absorbent layers held between a layer in contact with the wound and a base material. The absorbent layers absorb blood, body fluids, and exudates. The wound contact layer is non-stick and can be easily removed without disturbing the growth of new tissue. One of the products is non-woven alginate fabric [23]. When the calcium alginate fiber meets the sodium ions in the blood and exudates from the body, part of it is converted into sodium alginate. This process allows you to absorb and retain a large amount of liquid in the fiber. Eventually, the fiber will turn into a gel. This gel is hydrophilic, allows the passage of oxygen and blocks bacteria. Alginate dressing has been proven to promote new tissue formation. Wound dressing fabric types are Cotton, Viscose Silk, Polyamide Fiber viscose, polyethylene fiber viscose plastic film. The structure used in Wound dressing is Non-woven, Knitting woven [24].

2.1.4 Bandages

Bandage gauges are textile products those are used to support, retain, and help and to recover the wounds of the body. The bandage keeps the wound care layer in place. Wound care products those are adhesive in nature are also commercially available. The bandage can also be used autonomously in the case of orthopedic cases (for example, crepe bandage). There are various types of bandages along with their functions such as simple bandages that hold the dressing in place [25]. Fabric like simple bandages are Cotton viscose polyamide fiber. The structure used in simple bandage is Woven, Knitted, Non-woven. Elastic bandage, which provides support and compliance. Fabric types of the elastic bandage are Elastomeric-fiber yarns, Cotton, Viscose, Electrometric fiber. The structures used in elastic bandage are Woven, Knitted. Compression bandage serves as part of treatment or therapy for patients. Compression therapy is commonly used to prevent thrombosis and to treat lymphedema, ulceration of the leg. Fabric types of compression bandage are Electrometric fiber yarns [26]. The structure used in compression bandage is Woven, Knitted. The orthopedic pillow bandage provides padding and prevents discomfort. This type of bandage is mainly used as a pillow for comfort. They are worn under plaster caps and compression bandages. Compression bandages do a good job of compressing a new injury or inflammation and help maintain swelling. This bandage provides special support to help treat venous leg ulcers and control leg swelling [27]. The compression bandage is an effective way to treat specific types of ulceration. The leg ulcer breaks the skin of the leg and allows air and bacteria to penetrate the underlying tissue. The cause of this problem is vein disease in the leg. Blood clots can form deep in the veins to stay seated for a longer period. Eventually, this blood clot leads to an ulcer. The compression bandage provides adequate pressure to produce the desired clinical effect that allows control and reduction of swelling of the venous ulcer. Figure 3 shows compression bandage.

Figure 3: Compression Bandage [28]

2.1.5 Plaster

The fabric strips are extra flexible and breathable. Textile viscous plaster with a pad is intended to treat minor injuries, scratches, blisters, to cover the injection site, throughout vaccination or blood sampling. They are also suitable for covering all types of small daily wounds, such as scratches, cuts, and scratches. The material stretches with the movements of the skin, making them suitable for use on joints and other moving parts of the body. Viscose, Polyester fiber, Pasties film, Glass fiber, Polypropylene fiber types of fabric used in plaster. The structure used in plaster Knitted woven, Non-woven [29].

2.1.6 Gauzes

Medical gauze, a bleached white cloth or tissue used in surgical dressings, bandages, and sponges, is the most widely used dressing for wound care. Commonly known as "4 × 4s", the gauze is made of cotton, rayon, polyester, or a combination of these fibers. The woven gauze has an open and loose texture, which allows the wound fluids to be absorbed by the fibers, removed or passed to other absorbent materials in the dressing. Non-woven gauze is made of fibers pressed together to resemble fabric, providing better absorption and greater absorbency. Compared to woven gauze, this type of gauze produces less fluff and has the advantage of leaving less fiber in a wound when removed. Fabric types of Gauzes are Cotton, Viscose [30].

2.2 Implantable Medical Textiles

Implantable products are biomaterials that are used for wound closure, replacement surgery. Another significant grouping of implantable products is soft tissue implants. These flexible materials are commonly used to replace tendons, ligaments, and cartilage in reconstructive and corrective surgery. Braces and surgical reinforcement nets are used in plastic surgery to repair defects in the abdominal wall [31].

2.2.1 Sutures and Ligatures

The term "ligature" indicates the ligation of something like a blood vessel or peduncle, while "suture" indicates the stitching by means of a needle and thread in suture material. The sutures are strategically positioned after a surgical operation mainly to maintain the basic structural elements in the required places and to provide the necessary strength, held for a period of two weeks upwards, depending on the specific site [32]. Sutures are monofilament or multifilament threads used in surgery to close wounds. The ideal suture is a monofilament with a smooth surface that can pierce the skin without being caught and can be tightened into a single knot. The polybutylene terephthalate (PBT) suture is currently the most popular due to its acceptable strength and smooth surface.

Sutures are characterized as biodegradable or non-biodegradable. Biodegradable sutures are primarily used for internal wound closures. Fiber types of Biodegradable sutures are Collagen, catgut, polyglycolide fiber, polylactide fiber and fiber structure are monofilament, braided. Non-biodegradable sutures are used to close exposed wounds and are removed when the wound has sufficiently healed [33]. Fiber types of Non-Biodegradable sutures are Polypropylene fiber, polyethylene fiber, Polyester fiber, Polyamide fiber, Polytetrafluorethylene (PTFE) fiber. Fiber structures are monofilament, braided. These can again be of a natural or synthetic variety. The selection of the suture will depend on the physical and chemical characteristics and the biological culture of the tissue in which it is inserted. Chitin is considered an absorbable surgical suture with great mechanical properties, biocompatibility, and biodegradability. There are several studies on the use of resorbable surgical sutures. The chitin suture was absorbed in about 4 months in the rat muscles and showed negative responses to toxicity tests, including acute toxicity, pyrogenesis, and mutagenicity [34].

Natural absorbable sutures are Catgut prepared from the gut of the sheep inspected by the government. The great advantage of catgut is that it can also be used in the presence of an infection in which a non-absorbable suture cannot be used. The disadvantages of the catgut are the loss of tensile strength, purity, and questionable costs. Collagen was imaginary to conquer the inconveniences of catgut [35]. The flexor tendons of cattle are converted into sparse fibrils, which are extruded and reconstituted to form collagen sutures. The absorbable synthetic sutures are polyglycolic acid (dexon), which has the advantages of tensile strength, very low tissue reactivity, and good knots. However, the downside is that its tensile strength decreases within 15 days. The copolymer is a suture, which overcomes the disadvantage of polyglycolic acid since its tensile strength does not decrease within 4-6 weeks [36].

The non-absorbable natural sutures are silk, waste of silk, cotton, linen, while the synthetic ones are polyamide, polyester, polyethylene, and polypropylene. Ethicon's Vicryl plus is declared the first and only suture in the world that incorporates an antibacterial agent. It is designed to reduce bacterial colonization of the suture [37].

2.2.2 Artificial Ligaments

The artificial ligament is used to join two joints of a human body. It is a type of medical device. In the adult skeleton, there are 400 joints linked by ligaments. The ligament is a small band of hard, flexible, fibrous connective tissue that attaches two bones. The artificial ligament is a multilayer or tubular woven structure that has an intra-particular region, at least one fold region, and terminal regions. Artificial ligaments are made with artificial fibers such as polyester [38]. The use of the ligament varies according to the type of operation. Artificial ligaments are generally subject to much wear. They also carry a risk of septic arthritis. Characteristics of a prosthetic artificial ligaments is a multilayer or tubular woven structure that has an intra-particular region, at least one folded region and terminal regions, each region is woven to possess the required elasticity and strength, extremely resistant, adequate stiffness for normal ACL (anterior cruciate ligament), durability to withstand high-stress loads for millions of cycles without wear, perfectly tolerable for the host [39]. The artificial ligament must be biocompatible with blood and contact tissue. It's must-have good bonding strength. Polyethylene Terephthalate (PET) is mainly used for making artificial ligaments. Fabric types of artificial ligaments are Polyethylene Terephthalate (PET), Polyester, Silk, Polytetrafluorethylene (PTFE). Multiple filaments are mainly used to produce artificial ligaments [40]. The structure used in artificial ligaments is Braid. Figure 4 shows an artificial ligament.

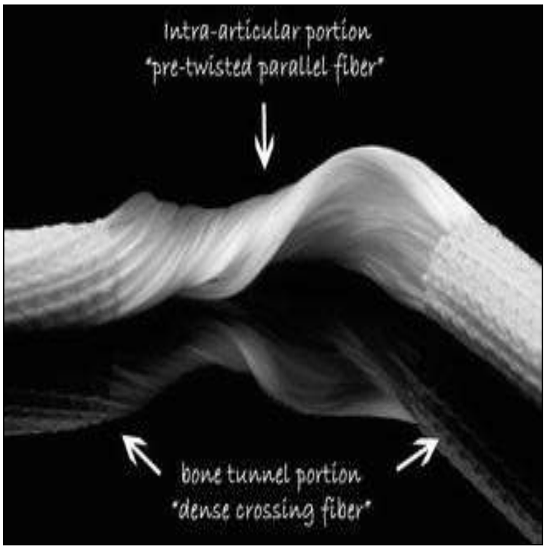

Figure 4: Artificial ligament [41]

2.2.3 Vascular Graft

The number of implants used in the surgical treatment of vascular diseases has increased steadily in the past 20 years, making it now considered a common procedure. These tubes replace or bypass part of a blood vessel, mainly arteries, and function similarly to natural blood vessels.

The vascular graft is an artificial vein or artery that is used to replace segments of the natural cardiovascular system that are blocked or weakened. The grafts are implanted to avoid blockages and restore circulation [42]. Vascular grafts are used for blood vessels, including arteries, and veins. Synthetic materials have been used in the design of vascular grafts for various reasons, mainly due to the ease and flexibility of adapting their mechanical properties. An example is expanded Polytetrafluorethylene (ePTFE), a porous polymer with a non-degradable electronegative luminal surface. However, only 45% of standard expanded Polytetrafluorethylene (ePTFE) grafts are patented as 5-year femoropopliteal bypass grafts, while autologous vein grafts show 60-80% patency. Vascular grafts fiber types are Polytetrafluorethylene (PTFE) fiber, Polyester fiber. The structure used in Vascular grafts are Woven, knitted [43].

The tissues produced in the tube form were used as implants to repair damaged arteries and veins. The typical diameters of these pipes are 6mm, 8mm, and 10mm. Vascular grafts are made of polyester or PTFE fiber, knitted. The woven tube has the advantage of good tissue encapsulation but is less satisfactory in preventing blood loss due to the loose structure of the woven materials. On the other hand, the braided tube is good for preventing blood loss, but it is not so good for tissue growth, due to its relatively narrow structure [44].

However, while progress has been made in vascular disease surgery, synthetic implants remain sensitive to thrombosis or coagulation, occlusions, and infections caused by adsorption of proteins and cells and activation of coagulation. Serious postsurgical problems occur in approximately 10% of surgical patients, including approximately 2%

of vascular transplant infections. As a result, some grafts need to be replaced only a few months after being implanted [45]. Figure 5 shows a vascular graft.

Figure 5: Vascular graft [46]

2.2.4 Artificial Skin

The characteristics of human skin depend largely on the hydration of the tissue, in simple terms, on the water content. This also changes their interaction with the tissues. Artificial skin is a laboratory-produced substitute for human skin, generally used to treat severe burns. The artificial skins fabric type is Chitin. The structure used in artificial skin is Nonwoven. The basic functions of the skin, including protection from moisture and infections and the regulation of body heat. The skin is mainly composed of two layers: the upper layer, the epidermis, which acts as a barrier against the environment; and the dermis [47].

Figure 6: Artificial skin [49]

The dermis also contains collagen and elastin proteins, which help give the skin its mechanical structure and flexibility. Artificial skins work because they close wounds, prevent bacterial infection and loss of water, and help heal damaged skin. The artificial skins imitate the epidermis or the dermis or the epidermis and the dermis in a "full thickness" skin replacement. For instance, a generally used artificial skin, Integra, consists of a silicone "epidermis" which puts off bacterial infection and water loss and a "dermis" found on bovine collagen and glycosaminoglycan [48]. Figure 6 shows artificial skin.

2.2.5 Artificial Cornea & Contact Lenses

Artificial cornea, this technology is used to eliminate blindness. Textile materials used in this field should be flexible and have good mechanical strength. Contact lenses are one of the most commonly used textile technologies today. Contact lenses change the color of your eyes and make them sweeter**.** It is made of water-absorbing material. For example, HEMA (Hydroxyethyl Ethyl Methacrylate) [50].

2.2.6 Hernia Repair

The links are used in hernia repair and replacement of the abdominal wall, where mechanical strength and fixation are very important. The fibers can be woven or woven into a mesh with each side designed with specific porosity and consistency to optimize their long-term function. Polypropylene mesh is a case in point of fabrics used in hernia repair. Polypropylene is resistant to infection and is hypoallergenic. The Gore-Tex soft tissue patch, used in hernia repair, is made of expanded PTFE [51].

2.2.7 Dental Biomaterials

The main supplies of dental polymers contain transparency or lucidity, constancy, good resistance and abrasion confrontation, insolubility in oral fluids, non-toxicity, moderately lofty softening points, and ease of fabricating and repair. The most used polymer for dental use is polymethyl methacrylate (PMMA) and its derivatives. Other materials for prosthetic based polymers are polysulfone and polyisulfone polyether [52].

2.3 Extra-Corporal Devices

Extra body devices are mechanical organs that are used for blood purification, such as apheresis, hemodialysis, hemofiltration, plasmapheresis, or additional oxygenation of the body's membrane. There have been artificial kidneys, liver, and mechanical lungs. The realization of these devices requires precise design, and manufacturing. Necessary requirements for these devices: antiallergic, anticancer, resistance to microorganisms, antibacterial, non-toxic and sterilization capacity [53].

2.3.1 Artificial Kidney

The mechanical device used to clean the patient's blood is called a dialyzer, also known as an artificial kidney. An artificial kidney would supply the profit of constant blood filtration. It would reduce kidney disease and improve the quality of life of patients. As blood flows through the kidney, it is cleaned by passing through thousands of small filters. The waste materials pass through the ureter and are stored in the bladder as urine [54]. It is made with hollow cellulose fibers to measure hair or hollow polyester fiber. The material used in the dialysis membranes are regenerated cellulose, cellulose triacetate, acrylonitrile copolymer, poly (methyl methacrylate), ethylene-vinyl alcohol copolymer, polysulfone and polyamide that can be grouped together as cellulose systems and synthetic polymers. 80% of dialyzers use cellulose materials that have excellent permeability for low molecular weight substances. Membrane pore sizes range from 1-3nm for conventional membranes to 4-8nm for large pore membranes [55].

2.3.2 Artificial Liver

Artificial livers are made of hollow viscose, to filter patients' blood and help remove waste. The liver aids in the digestion process and also metabolizes carbohydrates, lipids, and proteins. The liver also helps the body get rid of waste products. Waste products that are not excreted by the kidneys are removed from the blood by the liver. The artificial liver may act as an "auxiliary motor" for a patient during periods when the patient's liver has failed [56]. The patient recirculates the blood through the artificial liver, a process that requires various minerals. To avoid the problem of rejected cells, each patient needs a bioreactor. Hepatocytes perform many vital biological functions, such as synthesis and catabolic reactions, detoxification, and excretion. Thanks to their ability to restore a tissue-like environment, Hollow Fiber Bioreactors (HFB) show great potential among the different systems used for the culture of hepatocytes. Currently, the main use of hepatocyte Hollow Fiber Bioreactors is as bioartificial livers to support patients with acute liver failure, but they can also be used to synthesize cellular products and as cellular models for metabolism and drug studies of transport [57].

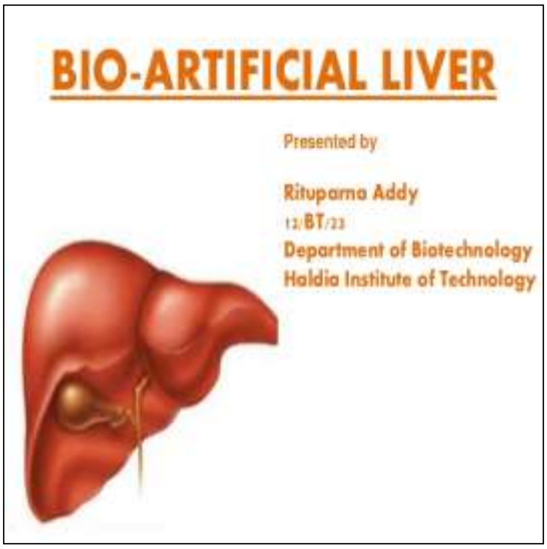

Figure 7: Bio-Artificial liver [60]

The artificial liver uses the functions of separation, removal, and supply of fresh plasma in hollow viscose fibers or membranes similar to those used by the artificial kidney to perform its function. In the case of extracorporeal devices, the cells grow to converge in devices that resemble dialysis cartridges and are then inserted into a "circuit" external to the patient's body, where the patient's blood flows through the cartridge, in contact with the cells and then back to the patient. Extracorporeal Liver Assistance Device (ELAD) or Bioartificial Liver (BAL) [59]. Figure 7 shows a bio-artificial liver.

2.3.3 Mechanical Lung

The lungs contain a fabulously twisted network of branched air pockets to allow gases to spread in and out of the blood (both O2 and CO2). The mechanical lung oxygenates the blood and removes carbon dioxide from the blood. The microporous membranes of the mechanical lung have a high permeability to gases but a low permeability to liquids and work in the same way as the natural lung. Polypropylene hollow fiber and silicon hollow membrane are used to create mechanical lungs [61]. The artificial lungs could provide an emergency solution for people who are recovering from serious lung infections. Silicone or polypropylene cave fibers are provided for mechanical lung fabrication to allow gas permeation. Ideally, it should work for at least 1-3 weeks. But the mechanical lung can only work for a week, because of its ability to remove carbon dioxide decreases. The lung is a form of the gas exchanger to supply oxygen to the blood and remove carbon dioxide. The best widely used and available membrane material is silicone, which not only has high gas permeability and low water permeability but can also be autoclaved [62]. Figure 8 shows a mechanical lung.

Figure 8: Mechanical lung [63]

2.3.4 Artificial Heart

An artificial heart is an appliance that transforms the original heart. Artificial hearts are usually used to fill up the time necessary for a heart transplant or to enduringly reinstate the heart in the moment that a heart transplant is unfeasible. At the same time as other comparable innovations preceded, the first artificial heart to be fruitfully implanted into a human being was the Jarvik-7, planned by a team that incorporated Willem Johan Kolff and Robert Jarvik [64]. An artificial heart is different from a Ventricular Assist Device

(VAD) designed to support a failed heart. It also differs from a cardiopulmonary bypass machine, which is an external device that is used to provide both heart and lung functions, which is used only for a small number of hours at a time, frequently throughout cardiac surgery. An eight-layer plastic pump covered with decomposed velvet fabric to reduce blood damage and it gives a camera apparatus the size of the human heart. Silicone backing makes fabric impermeable to rising gases wherever disagreeable the blood [65].

2.4 Sanitary and Hygienic Products

These products are related to daily use in hospitals and healthcare industries. These include clothes, surgical gowns, wipes, surgical cap, surgical masks, etc. All the fibers used in this product must be non-toxic, hypoallergenic, non-carcinogenic and must be capable of being sterilized without conferring any change in their physical or chemical characteristics. The range of these products available is wide, but they are generally used in the operating room or hospital for the hygiene, care and safety of staff, and patients. The production of fabrics for hygiene, and medicine is increasing, as is the variety of applications in this important sector [66].

2.4.1 Surgical Masks

Healthcare professionals should wear the surgical mask during surgery and while breastfeeding to trap bacteria spread in liquid droplets and aerosols from the wearer's mouth and nose. Simple surgical masks protect the user from splashing into the mouth with body fluids and prevents transmission of the body fluids from the user to others, e.g. the patient The general public wears surgical masks in East Asian countries to reduce the chance of spreading airborne diseases. Viscose, Polyester Fiber, Glass fiber is used in surgical masks. The structure of the fiber is Non-woven [67]. Figure 9 shows surgical masks.

Figure 9: Surgical masks [68]

2.4.2 Surgical Drapes, Cloths

These are also called sponges. Scrubs are the medical clothing worn by surgeons, nurses, doctors and other workers involved in the care of hospital patients. Originally designed for use by surgeons and other operating room staff. In many operating rooms, it is forbidden to wear exposed clothing, such as a shirt, under scrubs. Since exfoliants are designed to promote a clean environment, wearing outer clothing is believed to introduce unwanted pathogens. The clothes are available in a variety of models, such as unreinforced and reinforced ones. The performance characteristics are tear resistance, fluid barrier, abrasion resistance, and breathability. In most cases, curtains are sold as flat folded sheets, with film holders and a variety of special bearings and backs. Polyester fiber and Polyethylene types of fiber are used in surgical drapes, clothes, and the structure of fibers are Woven, Non-woven [69]. Figure 10 shows the non-woven absorbent sheet for surgical drapes.

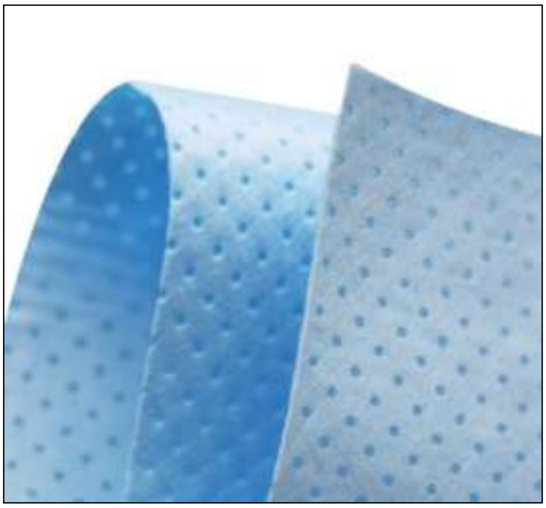

Figure 10: Non-woven absorbent sheet for surgical drapes [70]

2.4.3 Surgical Gowns

Surgical clothing is used to help prevent the wearer from contaminating vulnerable patients, such as those with weakened immune systems. Clothes are part of an infection control strategy. Disposable non-woven surgical gowns have been adopted to prevent the release of contaminating particles into the air, which is a likely source of contamination for the patient. Surgical suites are composed of non-woven fabrics and polyethylene films in a weight range of 30–45 g / m2. Cotton, Polyester fiber, Polypropylene fiber are used to make the surgical gown and the structure of the fiber is Non-woven, Woven [71]. Figure 11 shows a surgical gown.

Figure 11: Surgical Gown [72]

2.4.4 Surgical Cap

The surgical horn/cap that accompanies the surgical gown (below) covers the head, and sometimes the hair, the limbs of the surgeon. The purpose is to prevent contamination of the wound. Surgical caps are there to prevent harmful body fluids from spraying the hair and head of a doctor or nurse. It also works to prevent hair from affecting doctors' vision. On the other side of the spectrum, hair, or other contaminants like hair products or dandruff are dangerous to patients [73]. Medical caps are mainly made of non-woven structural and Viscose type of fabric, without adding harmful ingredients during production. Non-woven fabrics have good air permeability, so medical hats are non-woven and air permeability, sterilized with ethylene oxide. The product is clean and non-toxic, can effectively prevent cross-infection, clean, well-formed, easy to put on and put on and don't worry, it is beautiful and safe to use, and effectively prevent hair loss in the product. Better flexibility, faster recovery, better long-term wear, and the impact of apparent dust suppression can alleviate buoyancy problems, debris, microorganisms, etc. work [74]. The general thickness of non-woven surgical cap 13 g / m2 and 50 g / m2. Non-woven medical hats have many benefits. For example, high tensile strength, good air permeability, easy sensitive production, simple processing, low cost, cheap and practical, easy to use, can effectively repair hair and prevent slipping. Non-woven medical pieces can be made from PP non-woven bond spun or non-woven fabric ES, non-woven fabric, different materials can be used in different sectors. There are many types of materials, which can be selected by different users. They can also change based on user preferences, different colors, and types of printing [75].

2.4.5 Gloves

Medical gloves are made with different polymers, including latex, nitrile rubber, polyvinyl chloride, and neoprene; They are free of dust or powdered with corn starch to lubricate the gloves, making them easier to put on your hands. Corn starch has replaced tissue irritant powder and lycopodium talc, but corn starch can also prevent healing if it penetrates tissues (such as during surgery). Therefore, powder-free gloves are often worn during surgery and other sensitive procedures [76]. Special production processes are used to compensate for the lack of dust. There are two main types of medical gloves: examination and surgery. Surgical gloves have more precise dimensions with greater precision and sensitivity and are made to a higher standard. Examination gloves are available as sterile or non-sterile, while surgical gloves are generally sterile.

In addition to medicine, medical gloves are widely used in chemical and biochemical laboratories. Medical gloves offer basic protection against corrosives and surface contamination. However, they can be easily penetrated by solvents and various dangerous chemicals. Cotton gloves can be worn under disposable gloves to reduce the amount of sweat produced by wearing these gloves for a long period of time [77]. These gloves can be disinfected and reused. Polyisoprene surgical gloves are made of synthetic polyisoprene which offers properties similar to latex (natural rubber). In fact, polyisoprene has a molecular structure very similar to natural rubber. Polyisoprene is considered a "latex" glove without the harmful proteins present in the latex, which is responsible for latex allergies. Like other surgical glove materials, polyisoprene surgical gloves are available with an internal polymer liner, making it easier to use the gloves even when your hands are wet or dry. Of all the materials used for surgical gloves, polyethylene is the most expensive material [78]. However, most manufacturers of surgical gloves offer a choice of polypropylene gloves as adoption continues to improve due to its late nature. The three main manufacturers of surgical gloves are Molnlycke Health (formerly Regent Medical), Cardinal Health, and Ansell Health Care. Double gloves are put into practice of exhausting two layers of medical gloves to defend the risk of contagion by breakage or penetration of gloves by sharp substance throughout medical actions (used for patients with HIV and hepatitis, surgeons exhausting antivirus gloves). This should better protect patients from infections transmitted by the surgeon [79]. A systematic review of the literature indicates that double gliding offers greater protection against internal glove perforation in surgical procedures than using a glove layer. But it is unclear whether there is better protection against infections transmitted by surgery. The systematic review further examines whether a surgeon can be double the infection the patient suffers from. The results of 12 studies (RCT) with 3,437 participants showed that the double glove reduced the number of perforations in the inner gloves by 71% compared to a single glove. On average, ten surgeons/nurses involved in 100 operations underwent 172 individual perforations of gloves, but only 50 internal gloves would have been perforated with double gloves. This is a reduction in risk [80].

2.4.6 Diapers & Sanitary Napkins

A diaper or diaper is a type of underwear that allows you to wear a penis or urinate without using the toilet, with absorbent products or containing waste to prevent the soil from coming from external clothing or from the environment. They are mainly made with waste or synthetic materials. Fabric diapers are made with layers of fabric such as Cotton, Hemp, Bamboo, Microfiber, or Plastic fibers such as Polylactic Acid (PLA) or Polyester-Urethane (PU). Lockable diapers contain chemicals that are absorbed and thrown away after use [81]. Fabric diapers can be reusable and can be made of natural fibers, synthetic materials, or any combination of them. Cotton is used in non-woven hygiene products such as diapers, women's hygiene products, and Adult Incontinence Products (AIP). They are soft, unpleasant, hypoallergenic, and naturally absorbent and have a greater resistance than dryness. Currently, this material is made of fabric reinforced with fabric Spunlaid with Cotton, Viscose, Polyester, or Polypropylene (PP) fiber. Lightweight nonwovens (about 10-30 g / m2), in particular yarns, are considered winners of health products, both in terms of performance and costs [82]. The use of Spunbond fabric on diaper liners and incontinence tools has significantly decreased. This is due to the structural characteristics of the Spunbond, which help keep the user's skin dry and unhealthy. The spun fabric is considered convenient compared to other nonwovens. Nonwovens currently used in top sheet applications include Spunbond PP (generally producing multibeam systems), Spunbond / Blown Melt / Spunbond PP composites, and PP thermal bonding. The soft hands and hydrophobic properties make it acceptable that the Spunbonds in PP is more effective as a covering material for diapers and incontinence devices [83].

3. Conclusion

It has been seen throughout the paper that the importance of medical textile materials was discussed here. The textile materials that were applied in human medical treatments are expressed as medical textiles. Natural fibers, manmade fibers, and the combination of both natural and manmade fibers were used to produce medical textile products. Textiles are an essential part of the medical field. Medical treatment uses many materials, which are made of textile fibers. From surgical masks to operation theaters, from little sutures to artificial organs, there is a touch of textiles in everything. This blessing of medical science has brought hope to everyone. Earlier, if one man donated an organ to another person, it would only be possible to replace it, which is both distressing and expensive. But now thanks to the wonder of the combination of medical science and textile material, it has become very readily available. Now, besides the doctor's nurses, the common people are getting their protective material very easily. People can easily use masks, globes for protection. With the addition of textiles to medical, rare and expensive products have become readily available and costs have been reduced. Textiles are no longer just everyday use, and not just fashion stuff, they are now part of medical science. Textile quality fibers are being used as a complex medical and medical device, which is the light source for medical treatment. These materials are being manufactured in accordance with all the rules of medical science which are standard and 100% hygienic. As a result of the integration of textile and medical sciences, research in the medical sector is increasing and so is the scope of research in the textile sector.

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