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Exploring the versatility of medical textiles: Applications in implantable and non-implantable medical textiles

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Abstract

In the contemporary era, the realm of medical textiles stands out as a continuously expanding sector within the technical textile market. Essential characteristics of medical textiles encompass factors such as robustness, eco-friendliness, safety, compatibility with the human body, dimensional reliability, resilience against allergens and cancer, enhanced comfort, and efficient antifungal and antimicrobial properties. Advances in textiles, whether natural or synthetic, are primarily directed toward improving user comfort. Notably, the progress in medical textiles signifies a significant stride in making the challenging days for patients more comfortable. Implantable materials play a crucial role in addressing diverse medical needs by restoring affected parts of the human body. These substances are utilized in diverse fields, including the manufacturing of wound sutures, surgical substitutes, and the development of artificial ligaments and vascular grafts. This range encompasses a wide array of medical apparatus such as sutures, implants for soft tissues, orthopedic devices, and cardiovascular implants. The textile industry, especially in the medical, hygiene, and healthcare sectors, is witnessing a remarkable and growing trend. Textiles, due to their versatility in product design, have become a compelling solution for implantable medical devices. Textiles possess the versatility to adopt both two-dimensional and three-dimensional shapes, driven solely by imaginative ideas. In the medical realm, their utility spans from basic single-thread sutures to intricate composite formations employed in bone replacement. They serve purposes ranging from fundamental cleaning wipes to sophisticated barrier fabrics in surgical settings. This research seeks to investigate the diverse array of medical-grade textiles used as implants, such as surgical sutures, synthetic skin, ligaments, and cartilage replacements. The research delves into the diverse raw materials used in these textiles and examines the intricate manufacturing processes involved in creating these vital components of the medical field.

Keywords: Medical Textiles; Textiles Industry; Implantable devices; Intricate Manufacturing;

1. Introduction

Several essential characteristics of healthcare fibers encompass non-harmfulness, durability, suitability for living systems, and natural breakdown capability, excellent absorbency, soft texture, and purity without additives or contaminants. Textile materials, along with scientific techniques, are widely employed in medical and surgical applications for attributes such as robustness, adaptability, ease, and anti-bacterial properties performance. Healthcare material goods are primarily crafted from yarn composed of multiple filaments and yarn composed of a single filament, utilizing knitting, fabrics made through nonwoven and woven techniques, as well as those created through braiding, and composite structures [1]. The term 'medical textile' refers to textiles used specifically for medical purposes. Globally, the textile industry plays an increasingly significant role in healthcare and cleanliness sectors. Textiles used in

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the medical field are a dynamic research field within technical textiles, showcasing a diverse range of applications. These textiles are designed for medical applications, including Within the body, larger body, capable of being implanted, and not capable of being implanted, uses in biological buildings for assessing, treating, enhancing, or regenerating tissues, organs, or body functions (e.g., plaster, dressings, bandages, compression garments) [2]. Nazma et. al (2014) and Rahman (2015) interpret how supplier selection may affect the medical textiles sectors for an industry that plays significant role for Production Management [20,21]. Rahman et. al (2023) try to consider the cryptocurrency system which is the most important factor for medical textiles sector for choosing RAW materials [22]. Rahman et. al (2023) uses the machine learning algorithm which is very useful for this study specifically for the performance prediction of the raw materials uses for medical textiles sector. [25,24,23]. Sifat et al (2apaceimplements big data tool for MapReduce and Apace spark which is the future plane for this medical textile's raw material and component selection. Specifically, when the data size is more this research is very important. They use Multimode clusters with data compression methods and try to compare them which is significant for the expansion of our research when we select huge data [25,31,33]. Syed at el. (2023) describes gently how Brain tumor classification with transfer learning across the multiple classes for healthcare purposes. They use Deep Learning method and deep learning considers multistage neural network analysis which can be a very outstanding source of model for future medical sector and the raw material selection will be beneficial [32].

The growth of textiles in implanted, non-implanted, external, and sanitary goods is fueled by factors such as capacity to absorb, exceptional flexibility, gentle texture, robustness, lack of harmful substances, and compatibility with biological systems. While the transplantation method is a natural approach to substitute a malfunctioning anatomical component, the use of implantable textiles in the form of fibers and fabrics facilitates effective body repair in situations where transplantation is not feasible due to various reasons. Implantable textiles, such as stitches, implants for soft tissues, and grafts used in orthopedic and cardiovascular procedures., have contributed significantly to recent advances in medical science [3],[4]. Non-implantable materials are employed within outside programs, which could be either present or absent come into direct contact with the skin. These materials must possess qualities such as being non-allergenic, anti-cancer, anti-bacterial, air-permeable, excellent liquid absorption, high capillarity, wettability, moisture transport, and sterilizability. The primary applications of these materials include wound care and bandages, falling into two distinct and specialized areas: implantable materials (e.g., sutures, vascular grafts, artificial ligaments, artificial joints) and non-implantable materials (e.g., wound dressings, bandages, plasters, pressure garments, orthopedic belts, etc.). Fayshal et. al (2023) considers the environmental factors and safety risk assessment factor for the human and environment and this study has significantly depended on these factors [26,27]. Kamal et. al (2019) gives empirical evidence by using RFID technology for warehouse management by android application which has great impact on worker motivation to work in an textiles industry [28]. Parvez et. al (2022) gives a Great discussion on ergonomics factor of students from which we consider the human working posture for the efficiency measurement of worker in the electronics plant because ergonomics factors are one of the most crucial matters for the productivity improvement when raw material selection for component [29,30]. Ullah et al. (2023) describes very gently in his three different papers regarding manufacturing excellence, scheduling operation and equipment efficiency from which we can consider the raw material and component selection for the medical textiles sector [34,36,37]. Shakil et. al (2013) interprets the process flow chart for a jute mill which very informative for our medical textile research [36].

2. Implantable textiles

These materials are employed to substitute damaged organs or tissues in the body, necessitating non-toxic and biocompatible qualities. Typically utilized for the replacement of arteries, heart valves, joints, and similar structures, implantable textiles rely on two distinct types of fibers.

Biodegradable fibers: These fibers undergo degradation due to biological factors within a span of 2–3 months and are primarily employed within the body. Instances of these fibers include collagen, alginate, as well as specific variations of polylactide, polyglycolide, polyamine, and certain types of polyurethane. [5].

Non-biodegradable fibers: These fibers exhibit resistance to biological degradation over an extended period, making them particularly suitable for external applications. Examples of such fibers include Polytetrafluoroethylene, polyester, polypropylene, carbon, and various other materials. Key considerations for implantable textiles encompass factors such as biocompatibility and biostability. The success of implantation, especially concerning biodegradability, is influenced by the specific properties of materials like polyester.

Table 1 Medical textile products, raw materials, and function (Implantable textiles)

Product Name		Fiber types	Fabric types	Functions
Sutures	Biodegradable	Collagen, Lacticide, Polyglycolide	Monofilament, braided	Employed for securing bodily tissues post-injury or surgical procedures.
	Nonbiodegradable	Silk, Polyamide, Polyester, PTFE, Polypropylene.	Monofilament, polyglycolide braided	Employed to secure bodily tissues following an injury or surgical procedure.
Soft Tissue Implants	Artificial ligament	Polyester, carbon	Braided Nonwoven	An artificial ligament is a supportive material employed for the substitution of a damaged ligament.
	Artificial tendon	PTFE, polyester, polyamide, silk, polyethylene	Woven, braided	Applied in the restoration of the Achilles tendon, as evidenced by research conducted on equine subjects.
	Artificial cartilage	Low-density polyethylene		To replicate the functional characteristics of natural cartilage within the human body.
	Artificial skin	Chitin		
	Artificial cornea	Polymethyl methacrylate, corneasilicone, collagen		The device represents a significant advancement for individuals suffering from corneal blindness who have not accepted human tissue.
Orthopedic implants	Artificial bones/joints	Silicone, polyacetal, Polyethylene		Employed in the context of bone graft procedures.
Cardiovascular implants	Vascular grafts	Polyester, PTFE	woven, Knitted	Employed to establish a route for the circulation of blood from one location to another.
	Heart valves	Polyester	Knitted, woven	Inserted into the heart of a patient experiencing valvular heart disease.

Table 2 Medical textile products, raw materials, and function (non-implantable textiles). [6]

Product Name		Fiber types	Fabric types	Functions
Bandages	Simple inelastic/elastic	Cotton, viscose, elastomeric yarns	polyamide, Woven, knitted, nonwoven	To secure bandages on top of injuries.
	Light suppor	Cotton, viscose, elastomeric	Woven, knitted, nonwoven yarns	
	Orthopadic	Cotton, viscose, polyester polypropylene, polyurethane foam	Woven, nonwoven	
	Compression	Cotton, polyamide, elastomeric yarns	Woven, knitted	
Plasters		Rayon, synthetic film, cotton, polyester, glass, and polypropylene.	,Knitted, woven, nonwoven	Shields the wound and scab against rubbing, bacteria, harm, and contaminants.
Gauzes		Cotton, viscose	Woven, nonwoven	It proves particularly beneficial in bandaging injuries where alternative

			fabrics could adhere to the burn or cut.
Lint	Cotton	Woven	
Wadding	Viscose, cotton linters, wood pulp	Nonwoven	

2.1. Sutures

Suture is a broad term encompassing all materials employed to bring together body tissues, maintaining them in their natural position until the healing process is complete. These threads are utilized for restoring injured tissues, repairing severed vessels, and addressing surgical incisions by joining the fundamental outlines of injuries at specific locations. Sutures offer essential fortitude and a momentary shield to hinder undesired infections. The key factors influencing design of suture include applicability across the board, ease of handling, lack of deformities, winding, turning, or hovering, compatibility with living organisms, and lack of reactivity, consistent tensile strength concerning the style and dimensions of stitching used, a surface that facilitates smooth tissue movement while offering increased friction for reliable knot formation. Moreover, they should be sterilizable without compositional changes and undergo complete absorption with zero leftover after the healing process.

A suture functions as a thread that brings together and supports tissues during the healing process until the wound attains adequate strength or halts bleeding by compressing blood vessels. Wound closure sutures are available in various forms, including monofilament or multifilament threads, twisted, spun, or braided, and can be dyed, undyed, coated, or uncoated [7]. Patient safety is a crucial consideration in suture application. For instance, closing an incision in the lung requires a stitch possessing significant elasticity, a slow degradation rate, and elevated tensile strength. Consequently, the success of surgery depends on proper wound closure to facilitate timely and safe healing. Notably, the choice of suture morphology, such as braided or monofilament, can impact tissue swelling and susceptibility to infection, with a smooth suture (e.g., monofilament) being preferable to a rough one (e.g., braided) [8].

2.2. Categorization and Varieties of Sutures

Sutures can be categorized into 2 types based on their inherent nature and structure.

2.2.1. Absorbable Type (Assimilated Sutures)

The assimilated type of sutures is designed to be naturally taken in by the body, eliminating the need for a second surgery for removal. Examples of such sutures include catgut, collagen, and polyglycolic acid. Catgut, derived from ox bone, is a commonly used material for suture manufacturing. Despite its high absorbability, It is possible to insert it into the human body even when there is an existing infection. However, its strength decreases by 50% in the body within a span of one week, although a three-week recovery period is necessary for incisions post-surgery [9].

2.2.2. Non-Absorbable Type (Non-Assimilated Sutures)

Non-absorbable sutures are designed for prolonged implantation and necessitate subsequent extraction. Examples encompass cotton, silk, polyester, polyamide, and polyethylene. The use of cotton sutures demands meticulous aseptic technique due to their non-irritating nature, but their main drawback lies in being the least robust suture material. Silk filaments, with their gradual biodegradation and the requirement for surgical removal, pose challenges in various applications [9].

Sutures come in various types, such as monofilament, braided, pseudo-monofilament, and twisted strand sutures, each carrying distinct advantages and drawbacks. Monofilament sutures, crafted from a single filament of materials like polyester, polyamide, polypropylene, or polydioxanone, deliver smooth suture drag and minimal tissue drag. However, they exhibit relatively lower knot security and flexibility. Braided sutures consist of 8–16 polyester, polyamide, or silk monofilaments braided and coated with a lubricant to enhance flexibility. Pseudo-monofilament sutures feature a core of twisted materials coated with an extrusion of the same material, providing low tissue drag, good knottability, moderate knot security, and reasonable flexibility.

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Figure 1 Nylon monofilament suture

2.2.3. Intelligent Sutures

Intelligent sutures stand commonly used in surgical operations and other injuries. These sutures are utilized to tie plasma vessels or stitch tissue parts of the physique. Various kinds of absorbable seam filaments with intelligent characteristics are employed, mainly made from synthetic polymers. These materials are biodegradable and biocompatible, contributing to their effective performance in medical sectors.

2.3. Soft tissue implants

Biomedical materials applications involve the use of soft tissues, such as artificial tendons, corners, and prostheses. Tissue engineering research primarily focuses on two approaches: the in vivo road and the approach conducted in a controlled laboratory environment. The in vivo road aims to pledge treatments within the physique for repairing and regenerating spoiled or unhealthy tissues. This method holds promise for blood cell and nerve regeneration (both peripheral and spinal cord), skin repair, remodeling defective bone, cornea and retina treatment, and repairing damaged myocardium (heart muscle) post-myocardial infarction (heart attack).

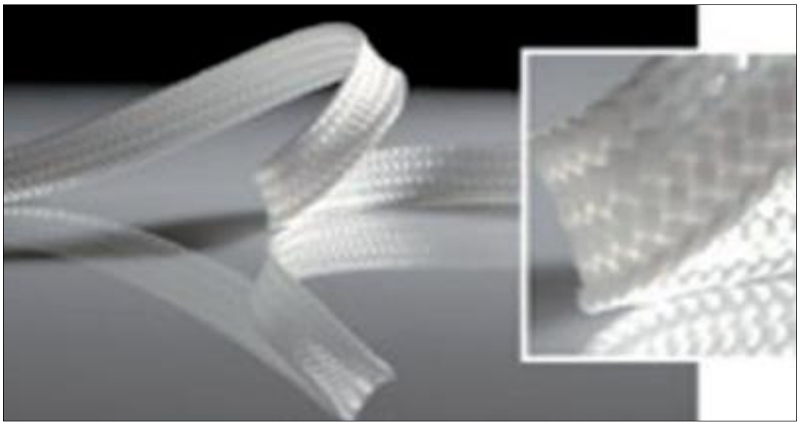

Figure 2 Woven ligament structure

While the *in vivo* route is effective for certain conditions, it may not address all diseases and injuries. For instance, complex tissue cultures are utilized for producing enzymes, drugs, growth factors, and for conducting toxicological and pharmacological assays. The choice between these approaches depends on the specific health sector claim. Ligament inserts serve to reinforce autologous transplants in construction or address functional residual instabilities. These implants are crafted through either the braiding process or a special flat knitting process, employing high tenacity polyethylene terephthalate or high tenacity polypropylene multifilament in the creation of artificial ligaments (see Figure 2) [10].

2.4. Hard tissues

Materials suitable for hard tissues must possess mechanical properties that align with those of hard tissues. Textile structural composites find application in implants, with desirable polymer traits including ease of processing, chemical stability, and biocompatibility for hard tissue replacement. Examples of applications involve artificial bones, bone cement, and synthetic joints. Presently, a common approach involves combining bioactive porcelains with polymers or metallic elements to enhance relating to or occurring at the interface characteristics. Fiber armor-plated compound materials are tailored to meet the necessary structural strength and biocompatibility requirements, gradually supplanting metal implants in the fabrication of artificial joints and bones.

2.4.1. Orthopedic implants

Orthopedics, a medical field focused on bone, joint, and muscle disorders, utilizes orthopedic implants for two main purposes: replacing bones and joints as hard tissue and stabilizing fractured bones with fixation plates. Early orthopedic implants were primarily metal structures. Fracture fixation devices encompass spinal fixation devices, fracture plates, wires, pins, screws, and adhesives, while joint replacements involve the hip, knee, elbow, wrist, and finger (refer to Figure 3). Materials such as polyacetal, polypropylene, and silicone are employed for orthopedic implants, with composite structures, combining poly (d, l-lactide urethane) and reinforced polyglycolic acid, displaying excellent physical properties. The sensor design aims to achieve a relative strain resolution as precise as 10-4–10-5.

2.4.2. Cardiovascular implants

As the patient population continues to increase and significant progress is made in analytic and healing approaches, vascular illnesses are gaining prominence in both general and clinical settings. Consequently, there is a pressing demand for vascular grafts.

Figure 3 Hip bone implants

Vascular grafts are utilized in surgical procedures to replace damaged arteries or veins. The introduction of both synthetic and biological grafts into the circulatory system can lead to various complications, including infection and structural issues such as enlargement, breakdown of the stitched seam, and defects like hovels or damages. Textile structures, commonly employed for arterial replacement, sometimes fall short of meeting all necessary requirements.

A notable solution is the gel weave, a twill-woven polyester graft with true zero-porosity. This graft is crafted by means of a progressive weaving method that involves completely textured polyester proceeding current looms (refer to Figure 4) [11].

Critical considerations for arterial grafts encompass absorbency, obedience, and ability to undergo natural decomposition. The strategy factors involve selecting the appropriate polymer type, yarn type, fabric, and crimping method. Polyester (e.g., Dacron), PTFE (e.g., Teflon), and polyurethane are among the most utilized materials. Commercial prostheses typically incorporate either single- or two-ply yarns. While round cross-section yarns are prevalent, trilobal yarns have been employed due to their larger surface area, facilitating faster preclotting. However, trilobal yarns are extra susceptible to exhaustion and motorized injury [12],[13].

Figure 4 Knitted structure for a cardiovascular implant

3. Non-implantable medical textiles

These materials are intended for external applications on the body, sometimes coming into contact with the skin and sometimes not. They encompass:

- Products for wound care
- Adhesive bandages (plasters)
- Orthopedic support belts
- Padding material
- Protective eye pads

3.1. Properties for non-implantable medical textiles.

- Durability: The ability to withstand repeated use and laundering without compromising structural integrity.
- Comfort: Providing a comfortable and non-irritating feel to the skin for extended wear.
- Breathability: Allowing adequate airflow to prevent overheating and promote comfort.
- Moisture Management: Efficient absorption and wicking properties to manage perspiration and moisture.
- Antimicrobial Properties: Resistance to microbial growth to maintain hygiene and reduce the risk of infections.
- Chemical Resistance: Protection against exposure to various chemicals and cleaning agents without degradation.
- Color Stability: Maintaining color integrity over time and after repeated washings.
- Non-Allergenic: Minimizing the risk of allergic reactions or skin sensitivities.
- Easy Cleaning and Sterilization: Capable of being easily cleaned and sterilized to meet medical hygiene standards.
- Tear Resistance: Withstanding wear and tear associated with regular use without compromising functionality.
- Flexibility: Allowing for freedom of movement without restricting the wearer.
- Cost-Effectiveness: Balancing performance with cost considerations for widespread use in healthcare settings.
- Regulatory Compliance: Meeting relevant safety and quality standards set by regulatory authorities in the healthcare industry.

Table outlining application areas and kinds of fibers commonly used for non-implantable medical textiles:

Table 3 Application areas and types of fibers commonly used for non-implantable medical textiles

Application Area	**Type of Fiber**
Hospital Apparel	Cotton, Polyester-Cotton Blends
Patient Gowns	Polyester, Polypropylene
Scrubs and Uniforms	Polyester, Cotton-Polyester Blends
Bedding and Linens	Cotton, Polyester-Cotton Blends
Wound Dressings	Cotton, Rayon, Non-Woven Fabrics
Bandages	Cotton, Elastic Fibers
Personal Protective Equipment (PPE)	Polypropylene, Polyester
Operating Room Drapes	Polyethylene, Polypropylene
Masks and Respirators	Polypropylene, Polyester
Compression Garments	Spandex, Nylon, Elastane
Orthopedic Supports	Neoprene, Elastic Fibers
Rehabilitation Aids	Polyester, Elastic Fibers
Hygiene Products	Polyethylene, Polypropylene
Towels and Washcloths	Cotton, Microfiber

3.2. Products for wound care

The wound contact layer plays a crucial role in dressing applications, aiming to prevent adhesion of the covering to the coiled and ensure easy removal lacking disrupting new flesh growing. Commonly employed dressings include gauge and paraffin-coated gauge. Gauges, often crafted from cotton in a loose plain weave, are frequently used. However, changing dressings for burns and skin graft sites needs to be done cautiously due to the potential pain and the risk of harming regenerating tissues. The removal process, aside from being painful, can impede the healing process by causing scarring and reopening wounds, potentially allowing bacteria entry.

Paraffin-coated gauge, typically multi-layered, offers a relatively easier removal process compared to dry gauge. It's worth noting that gauge may undergo impregnation with plaster, requiring sterilization. To mitigate the risk of irritation and potential carcinogenic effects, finishing agents like wetting agents and visual bleaching agent are deliberately omitted from gauge fabrics [14],[15].

- Enhanced sterilization capabilities
- A smooth and lint-free texture, reducing the risk of debris being left in the wound.
- The potential for increased softness and absorbency through processes like latex or thermal calendering
- The ability to create sophisticated nonwoven structures for post-operative dressings.
- Utilization of nonwoven fabrics made from filaments of atelocollagen as burn wound dressings.

3.2.1. Dressing material

Calcium alginate fiber

The primary raw material for manufacturing this fiber is alginic acid, obtained as an emulsion from marine brown algae. Alginic acid exhibits diverse properties, such as the ability to stabilize thick suspensions, create film layers, and transform into gels. When the dressing composed of this fiber is applied to a wound, ion exchange occurs, and the fiber is positioned on the wound in a dry state, initiating the absorption of exudates.

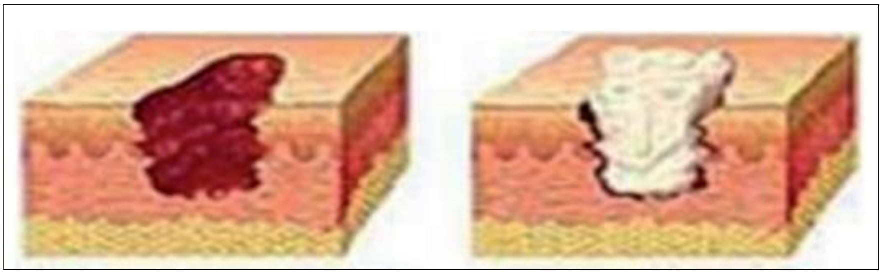

Figure 5 Sorbalgon wound dressing

Sorbalgon

Sorbalgon is a flexible, non-woven dressing crafted from first-class calcium alginate fiber, renowned for its exceptional gel-forming properties. This dressing exhibits the capacity to absorb almost 10 ml of exudates per gram of dry weight, as depicted in Figure 5.

Thin Film Dressing

Thin film dressings boast outstanding absorbent properties, and their outer surface, being thin, enhances comfort. This film's primary function is the efficient absorption of bodily fluids, ensuring secure containment within the dressing and preventing leakage and wound maceration.

Acticoat Dressing

Acticoat dressing surpasses traditional antimicrobial materials in providing superior protection against fungal infections. It stands out with an enhanced kill rate and increased effectiveness against various fungal species, showcasing improved performance in comparison to conventional alternatives.

3.3. Adhesive bandages (plasters)

Bandages should possess essential properties such as breathability, stretchability, non-slip characteristics, and a non-stick nature to enhance comfort during injuries. Their design caters to a variety of specific functions based on medical requirements. Typically, bandages, which are utilized in injuries and wound care, come in the form of lightweight knitted fabrics or open-weave woven fabrics, commonly crafted from cotton or viscose. Their primary role is to securely hold healing wound dressings in place, with no inherent healing functions [16],[17].

Orthopedic cushion bandages find application beneath plaster casts and compression bandages, providing padding to prevent discomfort.

Various types of bandages can be categorized as follows:

- A1: Lightweight conforming stretch bandages.
- A2: Light support bandages.
- A3: Compression bandages.
    - A3 (a): Bandages with light compression.
    - A3 (b): Bandages with moderate compression.
    - A3 (c): Bandages with high compression.
    - A3 (d): Bandages with extra high-performance compression.

3.3.1. Characteristics of various bandage types

- **Compression Bandages:** Compression bandages offer essential support to restrict movement and accelerate the healing process. They are utilized for the treatment and prevention of conditions like deep vein thrombosis, leg ulcers, and swollen veins. These bandages are specifically designed to apply a controlled level of compression on the leg consistently. Compression tapes are categorized based on the level of compression they can exert at the ankle, ranging from extra-high to light. They can be woven, containing cotton and elastomeric yarns, or knitted in tubular or fully-fashioned forms.

- **Compression Hosiery:** Compression hosiery serves as an alternative to compression bandaging for treating active ulcers. It is classified based on the pressure applied at the ankle. These hosiery products are made from various fibers, including nylon, cotton yarn, and elastane.
- **Orthopedic Bandages:** Orthopedic bandages involve saturating a cloth girth with a plaster of Paris, which is then wrapped around a fractured limb, creating a well-fitted yet easily removable cast in the form of a tube or cylinder. The modern plaster fabric is crafted from spun-bonded nonwovens using materials such as cotton, viscose, polyester, or glass fiber [18].
- **Pressure Garments:** Pressure garments play a crucial role in promoting proper wound healing and minimizing the effects of scarring. Continuous wearing of pressure garments is essential to prevent thickening, buckling, and nodular formations often observed in hypertrophic scars [19].

3.4. Orthopedic support belts

Orthopedic support belts are essential components of non-implantable textiles designed to provide support and stabilization to the musculoskeletal system. These belts are commonly used in orthopedic care to address issues related to the spine, abdomen, or joints. Key features and functions include:

- Support and Stability: Orthopedic support belts are crafted to offer support and stability to specific areas of the body, such as the lumbar spine, pelvis, or abdominal region.
- Posture Correction: Some orthopedic belts are designed to assist in maintaining proper posture, especially for individuals with back or spinal conditions.
- Compression: These belts often provide a level of compression to reduce strain on muscles and joints, promoting healing and alleviating discomfort.
- Adjustability: Many orthopedic support belts are adjustable to accommodate individual body shapes and sizes, allowing for a customized and comfortable fit.
- Breathable Materials: The use of breathable and moisture-wicking materials ensures comfort during prolonged wear, preventing skin irritation and promoting airflow.
- Versatility: Orthopedic support belts are versatile and can be used for various orthopedic conditions, including back pain, herniated discs, or post-surgical recovery.
- Non-Invasive Treatment: As non-implantable textiles, these belts provide a non-invasive approach to managing orthopedic conditions, offering relief without the need for surgical intervention.
- Ease of Use: Designed for ease of use, orthopedic support belts are typically adjustable and can be easily worn and removed as needed.

Overall, orthopedic support belts in the realm of non-implantable textiles play a crucial role in enhancing comfort, promoting healing, and facilitating the rehabilitation of individuals with orthopedic concerns.

3.5. Padding material

Padding materials in non-implantable textiles play a vital role in enhancing comfort, protection, and functionality in various applications. These materials are designed to provide cushioning, absorbency, and support, making them valuable components in products such as wound dressings, bandages, and orthopedic applications.

In wound care, padding materials are often incorporated into dressings to offer a soft and protective layer over wounds, minimizing discomfort and preventing external irritants. They contribute to the overall effectiveness of the dressing by promoting a healing environment.

In orthopedic applications, padding materials are used in braces, splints, and casts to provide comfort and support around joints and fractured areas. These materials are chosen for their ability to cushion impact, distribute pressure evenly, and ensure a snug yet comfortable fit.

The selection of padding materials depends on factors such as breathability, moisture-wicking properties, and the specific requirements of the intended application. Common materials include cotton, polyester, foam, and non-woven fabrics. Overall, padding materials contribute significantly to the functionality and user experience of non-implantable textiles in the medical and orthopedic fields.

3.6. Protective eye pads

Protective eye pads play a crucial role in non-implantable textiles, aiming to protect and facilitate the recovery of ocular injuries. Crafted from soft and gentle materials, these pads act as a protective shield for the eye, guarding against external contaminants, light, and mechanical trauma. Typically manufactured from non-woven fabrics or soft cotton blends, these pads prioritize comfort and breathability.

Frequently employed after eye surgeries, injuries, or for general eye protection, these pads often feature adhesive backing to securely adhere to the eye area, ensuring stability without causing discomfort during movement. Their non-implantable nature signifies their temporary usage, making them well-suited for short-term applications in eye care.

The core functions of these protective eye pads encompass infection prevention, reduction of irritation, and the creation of a favorable environment for healing. Their straightforward design, user-friendly application, and disposable characteristics enhance their effectiveness in post-operative care and first aid scenarios, establishing them as integral components in ocular healthcare beyond the scope of implantable medical textiles

4. Conclusion

In recent years, there have been notable advancements in medical textiles, driven by the introduction of biodegradable fibers that facilitate the creation of innovative implants. Additionally, sophisticated fabric machines now produce three-dimensional spacer fabrics. These developments have positioned medical textiles as crucial elements in modern disease management, especially significant given the growing elderly population in developed nations. The profound impact of medical textiles on promoting overall well-being and addressing past patient challenges is evident. The ongoing need for research in unexplored areas underscores the importance of continuous enhancement and the production of top-quality materials. Striking a balance between technological innovation and cost-effectiveness is essential to ensure widespread access to advanced medical textiles, maintaining their pivotal role in the evolution of various medical and surgical products.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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