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Review Article

Review on Protective Garments for Medical Care

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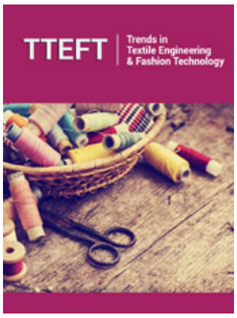
ISSN: 2578-0271



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Submission: August 24, 2020

Published: April 22, 2021

Volume 6 - Issue 2

How to cite this article: Giri Dev VR, Hemamalini T. Review on Protective Garments for Medical Care. Trends Textile Eng Fashion Technol. 6(2). TTEFT. 000635. 2021. DOI: 10.31031/TTEFT.2021.06.000635

Abstract

Protective garments play a crucial role by designing the clothing for both health care professionals and patients in the medical sector. The construction of the medical garments includes protection from pathogens, treatment garment to enhance the healing rate and caring garment to aid physical and mental disabilities personnel to have comfortable wear. The developments and innovation in protective garments are due to the combination of the conventional textile manufacturing with multi-disciplinary research in medicine and engineering technology. This paper shortly summarizes the garments used for medical textile and their construction required to meet the user's comfort and need.

Keywords: Bandage; Garments; Medical care; Medical textile

Introduction

Protective garments combine the properties of textiles along with additional functions in various application fields to comfort and offer protection to the wearer. This can be attributed to the inbuilt properties of fabric substrate such as lightweight, flexibility, dimensional stability and specific properties brought through altering fabric structure and surface modification. The other major advantage of textiles is ease of tailorabilty depending on the end user's comfort and requirement. Protective garments based on technical performance and functional properties can be classified as industrial, agricultural, military, civilian, medical, sports, and sports protective textiles [1]. The manufacturing of those protective textiles composed of natural and synthetic fibers utilizes conventional fabric manufacturing system such as weaving, knitting, braiding, embroidery, 3D weaving and nonwoven technologies along with advanced functionalization process such as physical and chemical modification, coating, inkjet spinning, lithography and nanotechnology [2,3].

Among other areas of application, protective garment finds its major application in medical sector by offering protection for medical personnel and the patients. The major limitation of traditional medical garments are poor fitting, discomfort and appearance of the garment which makes the wearers less likely to meet their psychological needs. Thus, the medical garment should be designed in such way that it should make the user to get a dignified and aesthetic appearance by encouraging their social connection with others thus maintain the functional and symbolic values of the garments. Medical garments can be classified based on specific functions such as protective, treatment and care. The protective function of the medical garments is to protect against the bacteria, physiological fluids, biological pollution and various harmful substances to the medical personnel and patients such as patient gowns, surgeon and laboratory coats. The treatment function of the garment enhances the healing of the treatment process by offering safety from infection and hazardous environments such as pressure garments and compression stockings. The caring function of the protective garments focusses on the tailored apparels to suit the physical and psychological requirements of physical and mental disabilities user [4]. Medical garments can be classified into health care products (face mask, surgical gowns, drapes), extracorporeal devices (kidney, liver, lung, heart spacer), therapeutic products (heating pads), non-implantable materials (bandages, wound dressing, pressure garments) and implantable materials (heart valves, vascular grafts, ligaments, tendons).

Development of Garments for Healthcare Applications

Medical drapes and gowns offer the protection from different infection and microorganism thus avoiding the transmission of diseases from patients to the health care professionals. The medical gowns are classified into three categories based on barrier performance such as standard fabric, reinforced fabric in which one layer of fabric reinforced to the other and impervious fabric which offers fluid resistance [5]. The major requirement of those gowns is enhanced liquid barrier performance and breathability and also offering other properties such as tearing strength, abrasion resistance and sterile fabric based on the selection of the materials. The polymers used for the production of those garments include polyester, polyethylene, and polypropylene. The manufacturing technique of disposable gowns utilizes nonwoven process such as spunlacing, spunbonded melt blown spunbonded (SMS) fabric, wet laid nonwoven fabric [6]. The non-disposable gowns are made of woven fabric with closely packed yarns which offers higher resistance against pathogens, contamination, and non-hazardous liquid light splash. Due to the high cost of laundering and sterilization for the reuse of the surgical gowns, single use surgical gowns are not used nowadays. The chemical finishes can be applied to the textile substrate to improve the barrier properties. The designing of the surgical gowns should provide an excellent barrier for the blood and body fluids to the anterior region of the healthcare professionals and also should have the long sleeve with no seams or closure ensuring the fit hence that does not allow the liquid penetration. In general, the sleeve portion is attached to the main body by bonding them with adhesives, heat, radiofrequency, or sonic energy to prevent the transmission of pathogens carrying liquids [7].

Hip protectors are commonly used in elders to reduce the risk of hip fractures during accidental fall. These garments are designed with protective shields under the pants which can be placed bilaterally along the trochanter region of the hip [8]. It can be classified into two types based on the installation of protective shields such as underpants with sewn-in shields and detachable shields. This can also be classified into two types based on energy transmission such as energy absorbing soft pads which absorbs the shock and energy shunting hard shields which distribute the loads along the hip region [9]. The knitted fabric of cotton and synthetic blend fibers offers higher recoverable stretch properties which make them suitable for hip protection garments [10]. The padding material made of polyethylene and polypropylene foam which was sandwiched between the under-pant garment should possess good energy absorption capacity, good durability, lightweight, good recovery after compression, ease of availability and reasonable cost. The designing of hip protectors depends on the body shape and size of the individual, thus making the garment without the bulgy appearance and more comfortable to wear for the elders [11].

Pressure garments also called as compression garments used for the treatment of venous ulcers and hypertrophic scars caused due to thermal, electrical, and chemical scars [12]. The pressure used for the treatment of the scar ranges between 10mmHg and 35mmHg to enhance the healing of the wounds. Pressure garments are constructed with elastomeric yarns along with cotton fibers with a wide range of pressure based on end use application [13]. The limitation of usage of elastomeric fabrics is slackness of the garments after prolonged usage due to the viscoelastic nature of the yarn which depends on the amount and direction of tension applied on the garments [14].

Varicose veins are the serious issue caused due to bulging or twisting of veins on the back of the calf muscles on the leg. This causes severe pain during walking and standing. The pain can be overcome by usage of compression stockings which uses the elastic material that exerts the steady pressure on the leg which improves the blood flow back to the heart and promotes peripheral circulation. The weave of the fabric and type of the material used decides the elasticity of the stocking material. Compressive stockings are manufactured using weft knitted structures comprising of polyesters, polyamide, and synthetic spandex. The construction of compressive stockings involves higher pressure at the ankle region compared to other regions of the leg [15,16]. It can be classified based on standards such as British and European standards. The standards are classified into three classes based on applied pressure such as light, medium, and strong compression. In British standard, the pressure ranges from 14 -35mmHg whereas European standard the pressure ranges from 18 -59mmHg. Thus, based on the level of varicose vein, pressure on the compression stocking can be increased, to reduce the pain on the legs.

Another milestone of textiles in the medical applications includes intelligent medical garments which sense and analyses the physical and biological data of the patients to actuate and control the response stimuli [17]. This can be done by embedding the sensors in the layer of the fabric or placing the intelligent devices on the garment which can be used to measure heart rate, respiratory rate, oxygen saturation, body temperature of the wearer. The adult diapers are made smart by incorporating a moisture detection system in the traditional diapers. When the diapers wets, the system either gives alarm or notification to the computer which intimates the caretaker to change the diaper to maintain the hygiene of the patients [18]. The garments must be designed to improve the comfort and aesthetic appearance of the elders. The stoma bag which was used to collect the discharge from the intestine to prevent the fluid flowing through the organs. Those bags are placed either on the left or right side of the umbilicus after the removal of sigmoid and rectum in the colon surgery. The positioning of stoma bag is difficult on wearing their day-to-day garments and feel of embarrassment when the bag is been by others, hence the underpants are designed with a pouch to support and conceal the stoma bag. The pouch with zipping can be provided to check the fluid content in the stoma bag without taking off the bag from underpants. Urology problems associated with bladder and kidney malfunctioning can be overcome by attaching a urine bag through urethra. The long plastic bag is connected to urethra by employing long catheter. The hanging of the bag which makes the wearer unhappy in the public place thus reducing the self confidence and self-esteem. Hence the modification has been made in the pant by replacing the patch pocket with long pocket to hold the urine bag as it is fully camouflaged inside the pocket without hindering the movement of the wearer [19]. The specially designed pocket also possesses a lower small opening for the discharge tube to pass through, which helps in emptying the collected urine in the bag.

Conclusion

Protective garments play a major role in increasing the quality of the patients by a slight modification of their casual garments. Textile garments offer a higher advantage in the medical field by ensuring the protection along with care and comfort of the wearer. It also improves the working environment of health care professionals by offering protection against the pathogens which can be transmitted from the patients. The constructional design, material selection and manufacturing techniques have to be accounted in the production of garments in the health care industry. Thus, textile based protective garments provide the solution to medical problems, enhances faster healing followed by care functions in biomedical applications.

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