INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230 – 8407

Review Article

A REVIEW ON TEXTILE IMPLANTABLE AND EXTRA CORPOREAL DEVICES IN MEDICAL APPLICATIONS

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Article Received on: 25/01/18 Approved for publication: 12/03/18

DOI: 10.7897/2230-8407.09335

ABSTRACT

The industry is growing at a incredible rate owing to its strengthening coverage, services and increasing expenditure by public as well private sectors. This worldwide increase in the average age of the human has, in turn, lead to a rapidly increasing number of surgical procedures involving bio implantation. The total industry size is expected to touch USD160 billion by 2017 & USD280 billion by 2020. Bio-Mimi city is one of the requirement for any kind of replacement and repair of any organ and other tissues. Bio compatibility is one of the major requirement in implantation of medical materials inside the human body. Textile materials are used in this field hugely because of its versatility. Recently up gradation of technology, innovation and invention provides platform to utilize the textile products in medical field. This paper is discussing about the use of implantable and extra corporeal devices made of textile products.

Keywords: Sutures, artificial eye lenses, coronary stents, artificial kidneys, artificial knees.

INTRODUCTION

In technical textile meditech is one of the fast growing fields, technological improvement and availability of sources as well as need increases medical textile product development. The textile materials like fibers, yarns, woven fabrics, nonwoven and composites are used in various applications in medical field. It starts from external application like wound dressing to internal organs like artificial kidney, liver and lungs etc. Each and every textile structures and design involved in various operations in medical field for example wound closure, wound dressing, blood purification. For the selection of textile in to medical application, some of the parameters are important, that is bio compatibility, non allergic, non-carcinogenic, non toxic and it can withstand all physical and chemical damage.

MEDICAL TEXTILE CLASSIFICATION

Medical textile products are categorized into following Implantable medical products like sutures, artificial tendon and ligament, artificial joint, vascular graft. Non implantable products are wound dressing, plasters, bandages, gauges. Extra corporeal devices are artificial kidney, artificial liver, artificial lungs.

IMPLANTABLE MEDICAL TEXTILE

Sutures

Sutures are natural or synthetic textile **biomaterials** widely used in wound closure, to ligate blood vessels and to draw tissues together. The original sutures made from biological materials such as catgut suture and silk[1, 6]. Most modern sutures are synthetic, including the absorbable polyglycolic acid, polylactic acid, Monocryl and polydioxanone as well as the non-absorbables nylon, polyester, PVDF and polypropylene. Absorbable (or resorbable) medical devices such as sutures are made of polymers. The polymer materials are based on one or more of five cyclic monomers: glycolide, l-lactide, p-dioxanone, trimethylene carbonate and ε-caprolactone[10]. Non-absorbable sutures are made of special silk or the synthetics polypropylene, polyester or nylon. Sutures are also classified according to their form. Some are monofilaments, that is, consisting of only one thread-like structure. Others consist of several filaments braided or twisted together[10]. (Figure.1).

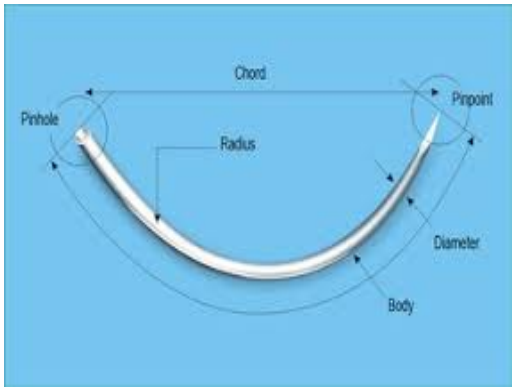


Figure.1: Sutures in Medical Field

Artificial tendon and Ligament

Artificial tendons and ligaments are used for foot and ankle. AC joint dislocations can be cured by using artificial ligaments due to their strong and flexible nature[11]. Polyester braided material used for these applications it has good biocompatibility and it enhances the growth of tissue. It is proven by biological test.AL has good mechanical strength and increase metabolisation. Carbon-fiber implants and Marlex mesh induce a fibrous growth that produces a neotendon or neoligament, depending on their use. Silastic-rod implantation establishes a hollow tube with qualities very similar to the normal tendon sheath. Carbon fiber and Marlex mesh are directly implanted and used as a temporary tendon or ligament. (Figure.2).

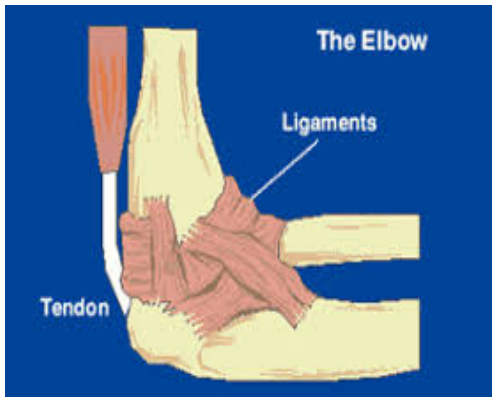
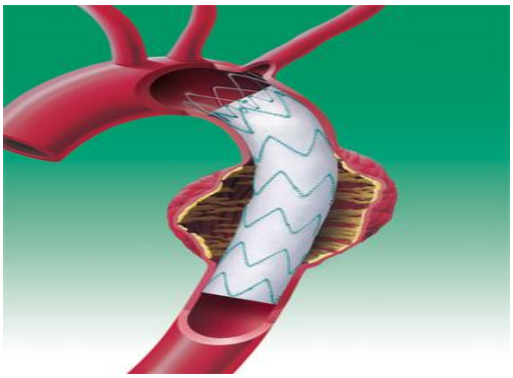


Figure. 2: Ligaments and Tendon

Vascular graft

Vascular implants are used for unhealthy blood vessels, now a day its used for redirect blood flow in coronary bypass heart operations, initially vascular implant was done by human own body or donar sites however these are limited supply and insufficient, considering these difficulties recent days researchers developing synthetic new vessels that mimic natural ones at the same time which allow cell growth as well. Those vessels are prepared using mixture of polyvinyl alcohol with chitosan by electro spinning method[8] , this method produce nano fibres increase surface to volume ration that will give good results in this area. Other than this PET, ePTFE are used for vascular graft prostheses.



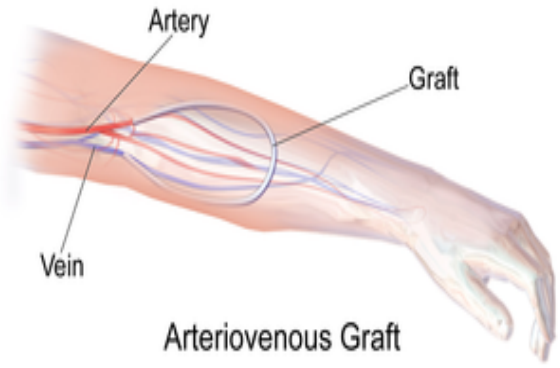


Figure. 3: Vascular Graft

Eye lenses

Hard contact lenses are made up of poly methyl methacrylonitrile and cellulose acetate butyrate[12]. (Figure.4)

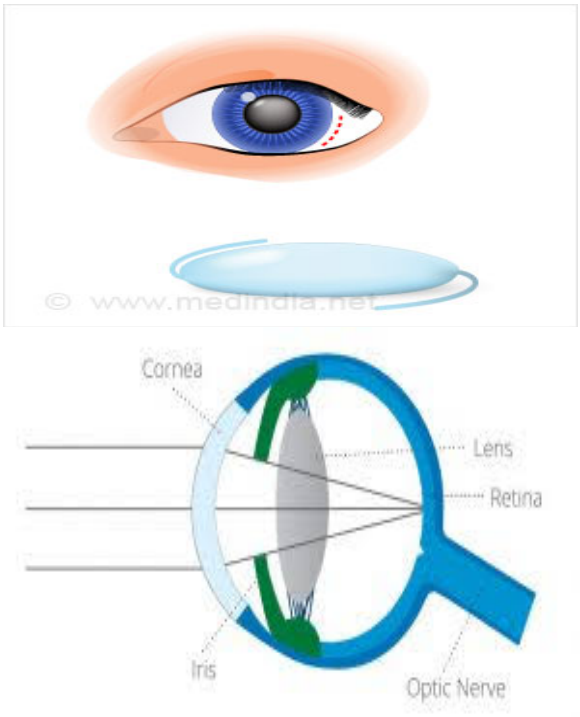


Figure. 4: Contact Eye Lens

Dental bio materials

The most widely used polymer for dental is Poly methyl methacylate (PMMA) and its derivatives. Other materials for for dentone base polymers are poly ether polysulfone[13]. (Figure.5)

Figure. 5: PMMA in Dental Application

EXTRACORPOREAL DEVICES

Artificial kidney

The main function of the kidney is filtering the waste from blood, if the kidney failure in human body, purification of blood process will stop that leads to patient die, in order to avoid the problem, researchers found an alternative one that's called artificial kidney that mimic the function of original kidney. Before the invention of artificial kidney they used dialysis for removal of waste materials from blood but the disadvantages is dialysis does not remove all waste from blood and it needs to do daily basis. Now a day's artificial kidney is introduced. Artificial kidneys are made up of Hollow viscose, hollow polyester fibre[9], cuprophan, Cuprammonium hollow fibre. Moderate mechanical strength and permeability, blood compatibility, suppression of complementary activation properties are required to produce artificial kidney[9]. Nowday's artificial kidneys are made by nano pore silicone membarane. In this system half of the portions made up of thousands of silicone membranes with nano pores and perfect in shape. So this kind of structure used for accurate filtering of waste from blood, here the force required for filtration is achieved by patient own blood pressure and it removes all toxins, sugars, water and salts. These are present in filtered solution.

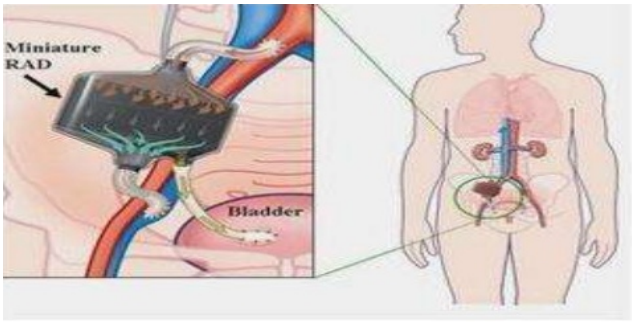


Figure. 6: Artificial Kidney

Artificial Liver

The function of liver is to separate and dispose of patient's plasma and supply fresh plasma. Hollow viscose is used to produce artificial liver[14]. Blood Compatibility, adsorptive activities need to be required to produce artificial liver.(Figure.7)

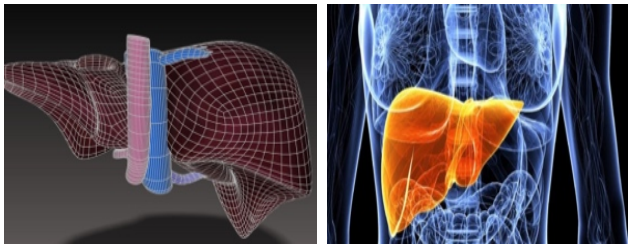


Figure. 7: Artificial Liver

Artificial Lungs

The function of artificial lung is to remove carbon dioxide from patient's blood and supply fresh oxygen. Hollow polypropylene fibre, hollow silicone, hollow silicone membrane are used to produce artificial lungs[16]. Gas exchange effect blood compatibility, suppression of blood plasma leak are the essential properties required to produce artificial lungs. (Figure.8)

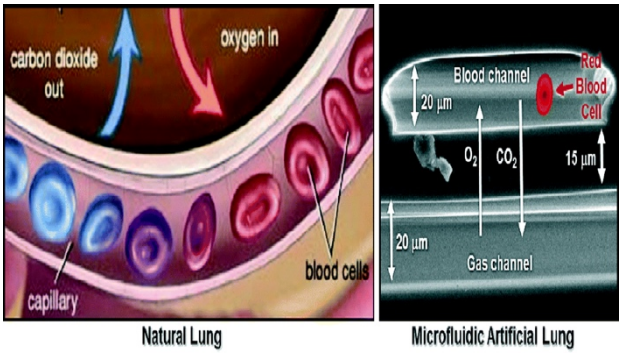
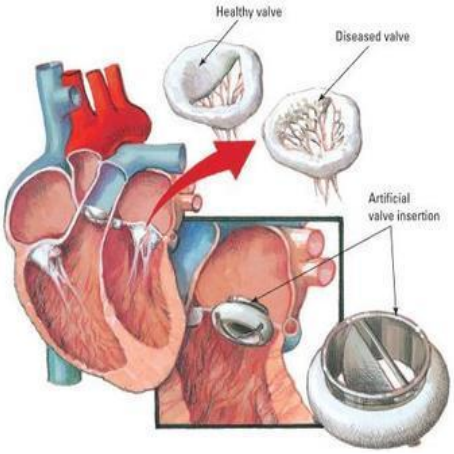


Figure. 8: Artificial Lung

Artificial Heart Valve

An artificial heart is a device that replaces the heart. Artificial hearts are typically used to bridge the time to heart transplantation, or to permanently replace the heart in case heart transplantation is impossible. The patients who are having problem in heart valves are fixed with the artificial heart valves. When human heart is not working due to blockage or leakage of blood they need to replace or repair one, for this purpose artificial heart valves are developed, there are two kinds of heart valve in use. Mechanical and biological heart valve that mimic original one. Mechanical heart valve is man made one it consists of pyrolytic carbon, tissue or biological heart valve has the following advantages, minimal leakage, trans-vascular pressure gradient, need not anti coagulants, low wear and tear. The biological heart valve is made up of ultra-high molecular weight polyethylene disc. 100% polyester fabric is used for stitching ring[14]. The warp knitted fabric with textured yarn is used for sewing ring. The advantages of the ring are good blood compatibility and tissue growth.



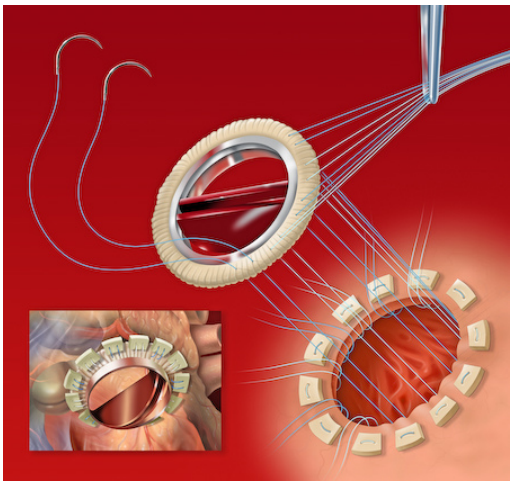


Figure. 9: Artificial Heart Valve

CONCLUSION

Human being is interested to live for more years. In this connection medical field in thirst to innovate and introduce new technique to increase the life time. Techno economics and the comfort ability are the important factors that will push the medical sector to provide space for new entities from all the fields. Textile is one of the versatile fields to introduce new innovative products in all aspects. Medical textile provides opportunities to use textiles in new areas. This review says that superior textile materials in the form of fibre, yarn etc., have been utilized for application where bio compatibility and strength are required and will clearly bring a new and improved cluster of medical implantable devices. As it is an inter- disciplinary field, collaboration between medical and textile technocrats is the need of hour. Pancreas, myocardium, bone and other replacements need more developments.

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Cite this article as:

Sri Sandoshkarthika *et al*. A review on Textile implantable and extra corporeal devices in medical applications. Int. Res. J. Pharm. 2018;9(3):1-5 http://dx.doi.org/10.7897/2230-8407.09335

Source of support: Nil, Conflict of interest: None Declared