Journal of Clinical Orthopaedics and Trauma xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Clinical Orthopaedics and Trauma

journal homepage: www.elsevier.com/locate/jcot

Review article

Medical textiles in orthopedics: An overview

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ARTICLE INFO

Article history:
Received 16 June 2017
Received in revised form 9 October 2017
Accepted 26 October 2017
Available online xxx

Keywords:
medical textiles
surgical gowns
face masks
shoe covers
sterilization wraps
suture anchors
fiber cast braces
Cotton
Nylon
Silk
Ultra-high molecular weight polyethylene
Polyester
Polypropylene
Poly tetra-fluoro ethylene
Polyether ether ketone
Polyether ketone

ABSTRACT

The use of textile in the medical field is not new; this has given rise to a new branch known as medical textiles. These are being used to repair or replace various other musculoskeletal tissues. The most common uses of biomaterials are to create aseptic conditions for protection, general health care, and hygiene including bedding and clothing, surgical gowns, face masks, head and shoe covers, sterilization wraps, suture anchors, fiber cast and braces/orthotics. These are also used as materials for preparation of wipes, swabs, wound dressings, bandages, gauzes, plasters, pressure garments, orthopedic belts and for new applications, such as heart valves, vascular grafts, artificial veins, artificial ligaments, artificial joints, artificial skin, and artificial cartilage. The truth is that nowadays the use of biomedical textiles is more rampant than anyone realizes. Commonly used materials for preparation of biomedical textiles includes Cotton, Nylon, Silk, Ultra-high molecular weight polyethylene, Polyester, Polypropylene, Poly tetra-fluoro ethylene, Polyether ether ketone, and Polyether ketone. These are prepared from various monomers in varying proportions as per the requirement of the material to be used. Various methods are used in their preparation like Braiding, Knitting, and Weaving, which helps in the development of certain kinds of materials with different specificity and character. Other important measures in the preparation of the medical textile include Denier (the filament counts in multifilament fibers), Tenacity (the strength per denier) and Heat shrink (the amount of shrinkage at a particular time and temperature).
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1. Introduction

The use of textile in the medical field is not new; this has given rise to a new branch known as medical textiles. Novel use of new and existing biomaterials in musculoskeletal procedures ranges from bone grafting to segmental fusion for spinal instability [1–3]. These are also being used to repair or replace various other musculoskeletal tissues like articular cartilage, meniscus [4] ligaments [5–7], and tendons [8]. The focus is now shifting towards lighter and softer implants instead of the old hard material implants.

The human body has dynamic complex biomechanical processes and therefore the material implanted or used over the human body should be inert and harmless. Mechanical properties play a significant role in the selection of materials for human use. Analysis of the biological behavior of synthetic materials is used to check the biocompatibility, using various in-vitro and in vivo standardized tests. Hench et al. [9] divided biomaterials into three different generations based on the evolution in the field of biomaterials and also as a result of learning from failed implantation.

2. First generation biomaterials – bioinert materials (1960–1980)

The choice of the material for a particular product is governed by matching the material properties with the indication of its implementation. Biological properties need to be added in the case of biomaterials, to the mechanical, chemical and physical properties. In the recent past, other conditions such as foreign body reaction (particularly due to wear debris), stress shielding, biocompatibility, bioactivity, and osteoinduction have also been introduced for the biomaterials used to design various implantable devices. Hench et al. [9] were the pioneers in introducing the

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https://doi.org/10.1016/j.jcot.2017.10.016
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Table 1
Classification of medical textiles based on their use.

Polymers	Used in preparation of
Polymethacrylic acid (PMMA)	Acrylic bone cements, anchoring of hip prostheses vertebroplasties and kyphoplasties
Polyethylene (PE)	Liner of acetabular cups in hip arthroplasties, tibial insert and patellar components in total knee arthroplasties
Polydimethylsulphoxide (PDMS)	Replacement for small joints in hand and foot
Polysulphone (PS)	Bone fixation devices, total joint arthroplasties
Polypropylene (PP	Bone fixation devices
Polycarbonate (PC)	Bioabsorbable fixation devices and bone regeneration drug delivery
Polyglycolic acid (PGA)	Bioabsorbable fixation devices and bone regeneration drug delivery
Polylactic acid (PLA)	Bioabsorbable fixation devices and bone regeneration drug delivery
Polycaprolactone (PCL)	Bioabsorbable devices for bone regeneration
Polydioxanone (PDS)	Bioabsorbable fixation devices,bone regeneration

Table showing the various polymers along with their uses.

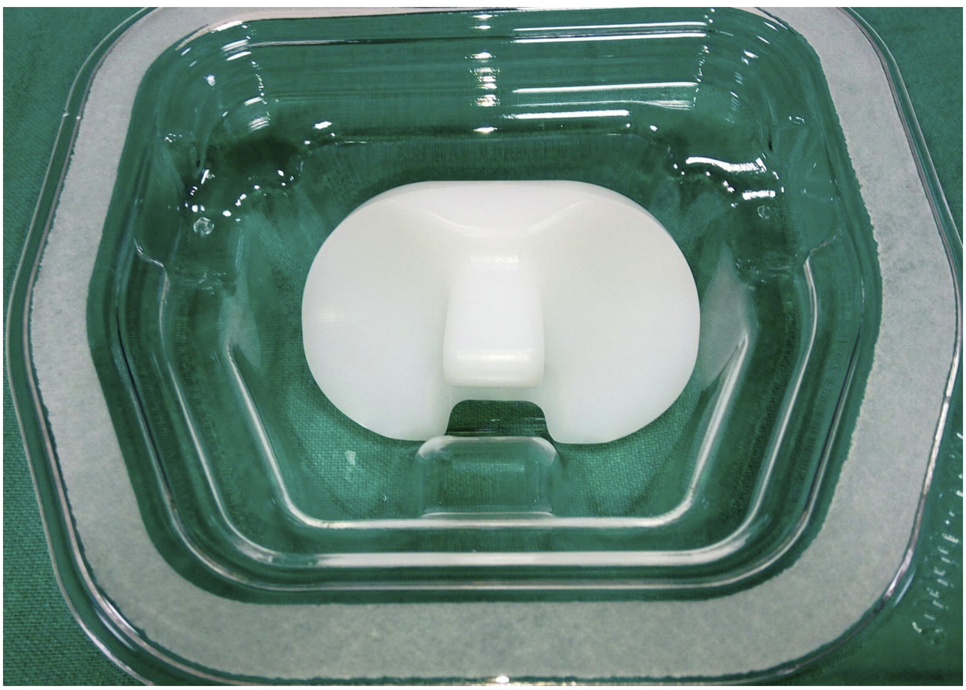

Fig. 1. Poly-insert used in total knee arthroplasty for stabilization of implants and smooth movement.

Table 2
Classification of Medical textiles based on their uses, type of fabric used, and fabric structure.

Utility	Advantages
1. Creating aseptic conditions 2. Closure of wounds 3. Immobilisation and support for fracture segment 4. Improved outcomes and rapid healing 5. Ability to engineer tissue integration 6. Optimal tissue support	1. Can be adapted to any part of the body and in any situation (flexible, soft and comfortable.) 2. Reduces the stiffness and are comfortable to wear 3. Can be used as an emergency immobiliser for accident victims 4. Can be re-used (cost effective) 5. Removal of these material does not require any specialised instrument 6. Cross infection is reduced 7. Protection of care providers 8. The comfort level is higher e.g. gowns 9. Breath-ability of non-woven is better 10. Engineered to have high barriers to blood and other body fluids. 11. Compatible with various types of sterilization techniques 12. In OT's they protect the user from static electricity 13. Surgeon friendly

Table showing the utility and advantages of the medical textile

materials which fit the first generation. According to them, the implanted material should do the job which the original structure was performed with no or minimal host response, and these materials were essentially 'inert.' They made use of metallic, ceramic materials and polymers such as silicone, rubber, polyethylene (PE), acrylic resins, polyurethanes, polypropylene (PP) and polymethyl methacrylate (PMMA) (Table 1). The most widely used amongst orthopedics is PE and ultra high molecular weight PE

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