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Materials used in medical implants

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There is a good sort of materials utilized in medical implants, starting from surprisingly simple to incredibly complex. What are the pros and cons of a number of the foremost common and newest medical implant materials on the market?

Materials used in medical implants vary from the well-known to the obscure. The following may be a collection of a number of the foremost common and innovative medical implant materials, starting from familiar silicone to new 3D-printed bio-materials [1].

Surgical mesh

Surgical mesh is formed from both inorganic and biological materials which are loosely woven together to make a sheet. These sheets are often used as either temporary or permanent support for organs or various other tissues during surgery. It is most commonly used for hernia or gynecological repair. Permanent versions of the mesh can stay within the body forever whereas temporary ones often dissolve away.

The material has been within the news recently as, like with many materials utilized in medical implants, the security of its use and potential side effects have inherit question. A rheumatologist from the University of Alberta in Canada found that prime reports of autoimmune disease symptoms in patients might be thanks to surgical mesh implants [2].

Silicone

Silicone gel is an inert polymer which causes no known human allergies or reactions. The material is typically heat-resistant and may be liquid or rubber-like in texture. It is well-known for getting used to form implant s for reconstructive surgeries and is usually chosen over saline breast implant options despite the upper risks should leakage of silicone into the body occur. The first silicone breast prosthesis was created within the 60s [3]. As with surgical mesh, silicone has come under scrutiny for complications such as breast implant-associated anaplastic large-cell lymphoma.

Silicone is also used to make other medical implants such as tracheal stents and, according to recent reports; the silicone tracheal stent market is set to grow.

Polyethylene

Almost all total knee replacement implants and lots of total hip replacement implants contain ultra-high molecular-weight polyethylene (UHMWPE). This plastic is important to supply cushioning and movement. Polyethylene is that the commonest plastic and it's often one among the materials utilized in medical implants because it's a porous synthetic polymer that's biologically inert and does not degrade in the body [4].

However, some polyethylene implants are considered better than others. A long-term follow-up study conducted in Australia confirmed that hip implants which contain crossed-linked polyethylene (XLPE) substantially lower the danger of a patient requiring revision surgery after a complete hip replacement in comparison to the consequences of implants that contain the traditional polyethylene (CPE) components.

High density polyethylene (HDPE) solid implants are employed by plastic surgeons since the 80s for facial augmentation purposes.

Titanium

Titanium is usually wont to make implants for dentistry but has more recently been used rather than chrome steel for other medical uses, like hip implants. Titanium is a non-allergenic and biocompatible material. It is also wont to make heart valves and bone screws. Its main advantage when wont to fix bones is that it can integrate with bone and is extremely strong but lighter than most alloys.

Despite being erosion-resistant and incredibly strong, titanium plates can cause bone embrittlement once bones are healed because the material is significantly more rigid than bone. Early this year scientists in Japan developed titanium fiber plates that are safer than conventional titanium plates when used to support broken bones [5].

Polyurethane foam

In the field of materials utilized in medical implants, polyfoam may be a fairly new addition. Researchers from the Hong Kong Polytechnic University created a scaffolding implant that encourages the regeneration of bone by combining shape memory polyurethane foam along with the bone tissue component hydroxyapatite.

Polyurethanes have a number of medical applications including catheter tubing, wound dressings and injection molded devices but their most common use is in short-term implants. The material has been used as a coating for a few breast implants, although there are involves a safer, non-biodegradable material to be found as an alternate.

Image Credit: The Hong Kong Polytechnic University.

Polylactic acid

As mentioned above, if a screw is employed during a surgery it'll likely be made from titanium. However, patients with titanium screws often need to have a second operation to possess them removed. To avoid this, surgeons have begun to use polylactic screws because they're biocompatible and biodegradable. One of the few issues with these screws is that sometimes the biodegrading process can leave holes within the bones they were intended to repair. Researchers at the Fraunhofer Institute for Manufacturing Engineering and Applied Materials Research (IFAM) in Bremen offered a solution to this by combining hydroxyapatite with polylactic acid to create a moldable

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composite which can be used to make medical screws that also promotes bone growth into the implant [3,5].

Image Credit: Fraunhofer IFAM.

3D-printed bio-materials

This category of materials utilized in medical implants is that the broadest as scientists still discover implantable materials which will be 3D-printed for medical purposes. 3D cell printing with a microfluidic approach has resulted in significant leaps in the vascularization of engineering tissues. With the use of biomaterials and polymerization techniques, precise replications of human tissues can now be replicated.

A 3D printing Bio pen device called Biosphere has recently been developed by researchers in Australia. The technology is essentially a device filled with stem cell 'ink' that allows surgeons to repair damaged bone and cartilage by drawing new cells directly into any damaged areas of bone during surgery [6].

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Conflict of interest

None

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