Journal of the Technical University of Gabrovo

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MATERIAL SELECTION IN DETERMINATION OF POSITION AND SIZE FOR ARTIFICIAL ORGANS

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ARTICLE INFO

Article history:
Received 19 September 2017
Accepted 24 January 2018

Keywords:
prosthesis, medical intervention, artificial material, material selection

ABSTRACT

The lack of a limb and function may adversely affect human life. This removal of acids in the treatment of medical intervention, repair or remedy possible. However, the human body and system in the human body anatomical differences in the standard prosthesis produced differences in the structure of harmony and repetition of the problems that may arise on the settlement of the transaction, can lead to movement in human life and health. In addition, this prosthesis, but the adjustment process after the placement process can be monitored. In this process, the most common problems can emerge as a good physician and operations despite sinking prosthesis prosthesis over the slightest slip uncomfortable situations based on location. Physician experience is very important for the placement of the prosthesis. However, if a physician's experience in achieving a higher number of subjects studied it is inevitable. Total joint replacement, adding that changing the damaged joint surfaces of artificial materials with function again gain stability and aims to eliminate the existing pain. Thanks to the support of the design and modelling success during assembling prostheses to be made available to increase the percentage increase in our study, the cost of these works to eliminate the risk of failure and contributes to better quality of human life. Experience and intuitive approach of physicians able to offer insight into the process as well bite the positive approach in science as we define additional targets.

In this study, 3 steps have been applied to place a special prosthesis. Firstly, the choice of material for the appropriate prosthesis. In the second step, the size and position of the prosthesis that will be specially needed will be scanned and produced. Finally, placement of the prosthesis in the body was carried out. As the first step in this article, the selection of the right material in denture production has been examined.

INTRODUCTION

The production of medical prosthesis in our country, national industry and external dependency studies have recently been emphasized. The dynamic structure of the medical sector and follow-up of developments and developments should be closely monitored in terms of our country. Reduction of external dependency on raw materials to achieve this goal, Value-added products, blood-based policies and strategy development are priority steps [1]. Our work focuses on bringing prosthetic products out of the way and tailoring these products to the needs of end users.

Hip osteoarthritis [2-4] is a disease that causes degeneration of the hip joint in elderly people, resulting in pain and limitation of movement. The physical limitations caused by the resulting symptoms cause serious deterioration in the quality of life of the patient. Significant changes in the treatment of osteoarthritis have occurred with joint prosthetic surgeries. The goal of hip prosthesis is to remove the pain from the hip, restore function with increasing movements, and thus increase the quality of life of the patient. This surgery places a heavy burden on the health budget in every country it operates. It is expected that the expenditure of joint prosthesis surgery will increase every year with the increase of the elderly population in the society. For this reason, validated, accepted, and change-sensitive outcome measures should be used in clinical trials to determine the benefit of osteoarthritis treatment [5].

One of the main outcome measures for osteoarthritis, as in all diseases, is the change in quality of life. General or disease-specific quality of life scales can be used to determine this change. General quality of life scales has the potential to better identify side effects and complications related to treatment that are not directly related to the disease. Especially in patients with osteoarthritis, general quality of life scales provides a holistic view because of accompanying diseases. While it is suggested that general scales are less sensitive to the patient's health changes, there is now a trend towards general quality of life scales because of the evaluation of side effects, complications, and comorbidities [6].

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Today, movement restriction due to the lack of an organ or structure of individuals is being reduced by orthosis and prosthetic technology. Prosthetics: Vehicles, tools and devices that can take the place of a non-organ; Orthosis refers to instruments, devices and devices used for facilitating, restricting, fixing, assisting, preventing or correcting the movements of any organ of the human body [7]. The tasks and forms of these structures are produced in the same way. However, despite the anatomical resemblance, one of the individual differences is also a physical measure. When an artificial structure is placed in the human body, the difference must be considered according to the physical measures of the person. Some problems may arise when an artificial organ is placed in the vicinity. [8-10]. Surveys conducted in this context also carried out satisfaction surveys for prosthetic use for patients [11].

Araz (2005) developed a pulsatile loading analysis in the hip fracture treatment area in his master thesis. Here, the values obtained on the basis of the dynamic analyzes made with ANSYS for three different types of prostheses were compared with the prosthesis number three of the first and second sample prosthesis. In the study, he determined the first and second types of prosthesis models which are more suitable for healthier use and more resistant from the medical point of view. [12] In similar studies performed, prosthetic needs were analyzed by end-to-end program analysis and significant results were achieved [13-15]. Jaw prostheses are manufactured with 3D printer. Materials and designs made of prosthetic materials have been tried to provide comfort, fit and fit for prosthesis use [16].

In the work done, the application of the creation of objective modeling with a wider perspective, product development technique and technology, has been realized. In addition, personalized design involves investigating new ways to transition, as materials and designs on the design cannot meet personality-specific features.

BIOMATERIAL

Stainless Steel (316L)

Iron, carbon and trace amounts of phosphorus, silicon and manganese steel, carbon steel is called. Alloy steel is made of steel with less than 1% carbon content and containing other metals and nonmetals. The steels in this group are more expensive than carbon steels and are more difficult to process. However, their corrosion and thermal resistance are much higher. Alloy steels may contain aluminum, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, phosphorus, silicon, sulfur, titanium, tungsten and vanadium. While aluminum increases resistance to abrasion, high added chrome increases corrosion resistance and thermal resistance. Such steels are called "stainless steel". The first metallic biomaterial made of stainless steel is a 18/8 Cr / Ni stainless steel implant [4,5].

Cobalt Alloys (Co-Cr)

There are two types of cobalt-chromium alloys used as biomaterials. These;

- CoCrMo
- CoNiCrMo alloys.

CoCrMo alloys are used in dentistry and newly developed artificial joints. CoNiCrMo alloys are used as prosthetic handle materials in hip and knee joints, which bear heavier loads than CoCrMo alloys.

In CoCrMo alloys, corrosion resistance to alloy solutions is provided at 65% Co which constitutes the material composition. Addition of Mo results in a reduction in size of the particles of the material structure, thus improving the mechanical properties of the material. Increasing the amount of Cr further improves the corrosion resistance against solid solutions of the alloy [4-8].

Titanium Alloys (Ti6AI4V)

Ti6Al4V is the most widely used titanium alloy today as biomaterial. It has been used as a biomaterial since 1930. This alloy consists of 5.5-6.5 % aluminum, 3.5-4.5 % vanadium, and the remainder titanium. The greatest advantage of titanium alloys is that the corrosion resistance and biocompatibility are higher than other metallic materials. The modulus of elasticity of titanium is about 110 GPa, which is about half of Co alloys. However, these materials have high abrasion resistance. Titanium is a very reactive material at high temperatures and reacts quickly with oxygen [9].

Polyetheretherketone (PEEK)

PEEK polymer is one of the prominent polymers of the semi-crystalline thermoplastic polymer class. Research on this organic polymer with excellent physical properties is based on the 1960s. The polyether ether ketone (PEEK) polymer, consisting of a chemically repetitive ketone and two ether groups, has a linear structure in a fully aromatic, high-quatity state due to its structure containing only carbon, hydrogen and oxygen atoms [9-12].

Polymethyl Methacrylate (PMMA)

Polymethyl methacrylate (PMMA), also known as acrylic glass or plexiglass in the market, is a colorless and transparent thermoplastic polymer. In general, cama is preferred as an alternative material, and because it has similar properties to polycarbonate, products using polycarbonate may be an alternative. Although it is cheap and easy to process, it is preferred because it has a fragile structure.

METHOD

The choice of materials made without sufficient knowledge about the structure and properties of materials can prepare many small defects environment. Wrong choices cause difficult situations to occur because they will affect other phases of the study in a big way. [17] When material selection is made, it is necessary to pay attention to many properties related to materials. When selection is made, properties such as strength, ductility, design, stability, availability, manufacturability and cost are of great importance. Strength, Ductility: Design Stability or Sustainability; Manufacturability, Cost The material to be used in the work, the design, the supply of the material, the manufacturing process, the cost of the material directly. If the performance of the material does not meet the cost of the material, the preference of the material is low [18]. Apart from these properties, the biocompatibility properties mentioned earlier are an important title depending on the field of application for material selection.

Ashby material selection method is used to make appropriate material selection. First, properties such as strength, elasticity density, elongation, thermal properties and cost of materials are determined. Shown in Table 1.

In addition to these properties, we analyzed the Ashby material selection method according to the biocompatibility and strength parameters of our sample materials. It is shown in Fig 1.

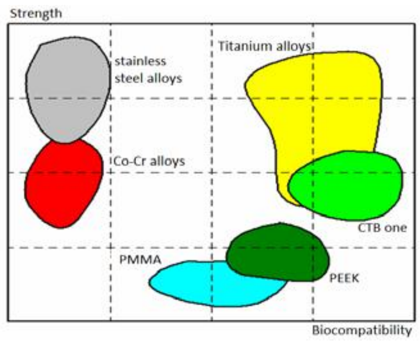

Fig. 1. Biocompatibility and strength parameters

As shown in the relation between biocompatibility and strength, the best material is CT Bone and Ti6Al4V materials. The worst material is PMMA. This is why the risk of infection with PMMA is high and the wear resistance is low. If the abrasion resistance is low, cracks can form inside the body, wear and tear.

Table1: *Ashby material selection method is used to make appropriate material selection.*

	Strength (MPa)	Elasticity (GPa)	Density g/cm^3	Elongation	Thermal °C	Budget $
Cortical Bone	**120**	**15**	**2**	**1,4**	**Unknown**	**Non-commercial**
CO – Cr Alloy	655	230	8,5	8	1300	90
Stainless steel	860	200	8	12	1400	70
Ti6Al4V Alloy	860	110	4,5	10	1650	350
PEEK	100	3,5	1,3	3,4	300	80
PMMA	70	2,9	1,19	2,5	180	12
Cortical Bone	110	30	1,85	2,5	47	?

CONCLUSION

Generally; In the selection of biocompatible materials, properties such as strength, ductility, design, stability, availability, manufacturability and cost come to the forefront. For skull prostheses, first of all biocompatibility selections should be followed by analysis of the mechanical properties to provide strength, according to the mechanical loads to be determined by considering the daily activities of the person. In this study, the most used materials in health field were investigated and their characteristics were given as tablings and compared. According to Ashby's method of material selection, things were done from these materials. Using the Solid Edge ST8 program, the strength analysis of the remaining materials was performed after the sieving step. The strength of all the materials we analyzed was qualitative compared to the operations we carried out during the elimination phase. But the order was set at this stage. Biocompatibility orders were also obtained in earlier stages. As the first factor is biocompatibility, our front panel materials were CT Bone, Ti6Al4V and PEEK materials respectively. The strength analysis of these materials also provided the necessary results. Final selections were made from these materials. Although our first choice is CT Bone material, this material is owned by a private company, and because it holds shareholding rights, it becomes the first choice if this material is available. If access to this material is difficult, Ti6Al4V material will be the first choice. The only disadvantage of this material relative to the PEEK material is the cost, so if the application is made with the preliminary cost, PEEK material will be the first choice.

ACKNOWLEDGEMENTS

This work has been supported by "The Scientific Research Project Program of Marmara University (Project no: FEN-C-YLP-070617-0362)

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