REHABILITATION OF THOSE WHO LOST LIMBS FROM SHRAPNEL AND GUNSHOT WOUNDS

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Abstract. *In today's reality, unfortunately, there are many people who have lost limbs due to tragic circumstances. To solve this problem, there have long existed a variety of artificial prostheses designed to ensure the integration of the victim in society, but the current products on the market are expensive and need to be customized for each user individually, by highly qualified personnel. In order to solve the above-mentioned problems and to increase the comfort and safety of using the prosthesis, we decided to develop an electronic device that would simplify the process of fitting the prosthesis to a particular user, improve its comfort and increase the period of safe wear of the prosthesis.*

Keywords: *Disaster medicine, prosthetics, lost limbs, effect of electric potentials, electronic device.*

Introduction

In today's reality, unfortunately, there are many people who have lost limbs due to tragic circumstances. And every day such people with disabilities face difficulties in leading an active lifestyle. This problem is especially acute when the injured person, due to his/her professional activity, is obliged to behave as if the injury had not occurred [1].

To solve this problem, there have long existed a variety of artificial prostheses designed to ensure the integration of the victim in society, but the current products on the market are expensive and need to be customized for each user individually, by highly qualified personnel.

Also, modern artificial prostheses are not designed to be worn all day long, due to the imperfection of the fixation [2].

A person using a prosthesis will inevitably encounter problems with chafing, not to mention the fact that he or she will need a long process of adaptation to the prosthesis before wearing it directly [3].

There is also an increased risk of thrombosis due to blood stasis and increased pressure on the limb from the prosthesis.

In order to solve the above-mentioned problems and to increase the comfort and safety of using the prosthesis, we decided to develop an electronic device that would simplify the process of fitting the prosthesis to a particular user, improve its comfort and increase the period of safe wear of the prosthesis [4].

Analytic review on the state of problem solving.

Different types of amputations require different prostheses. The easiest way is to replace the loss of fingers, but with amputation above the forearm, serious difficulties begin. It is worth clarifying that the reason for installing a prosthesis can also be various congenital mutations that lead to deformation of any part of the limb [5].

Now, it's worth saying what types of prostheses exist today, now there are two main types [6]:

- Traction (mechanical)
- Bioelectric, based on the work of myoelectric sensors, are the most advanced

Traction (or mechanical) prostheses are a frame with many cables (traction). The essence of their work is simple. Special cables are fixed to certain areas of the remaining limb [7]. With the help of force, the cables can be stretched, which leads to bending (or some other) movement of the prosthesis. These prostheses are suitable for any type of amputation, even complete loss of an arm (Fig. 1).

Figure 1. Traction foot prostheses for sport

The prosthesis consists not only of a frame, a sleeve and a hand, but also has a cable. It is attached to a healthy shoulder, due to which the bend and extension of the hand are performed. Control in the elbow area can be carried out using the healthy arm, or by lifting the prosthesis with the body [8].

Mechanical prostheses are very suitable for children, because constant loads during control prepare them for a possible transition to electronics. To summarize, the main advantages of traction prostheses (Fig. 2) are [9]:

- Low cost
- Resistance to damage
- Possibility of installation for shoulder amputation
- Much less weight of the prosthesis compared to bioelectric ones.

Figure 2. Traction hand prosthesis

However, progress did not stop there. The fact is that traction prostheses have only one strict type of grip; therefore, we can say that traction prostheses are designed for some narrow function, which is not always useful in everyday life [10].

The work of bioelectric prostheses is based on reading the electrical potential of residual muscles. The impulse goes from the brain to the spinal cord, where it further diverges and enters the nerves connected to the muscle fiber (Fig. 3).

The signal is amplified, after which the signal disperses along the branches of the nerve, axons, into certain groups of muscle fiber. Several muscle cells can be recruited from one nerve. In a healthy hand, the signal successfully reaches the palm and you squeeze it, but if the hand is amputated below the elbow, the signal dissipates. The reading function is performed by myoelectric sensors [11].

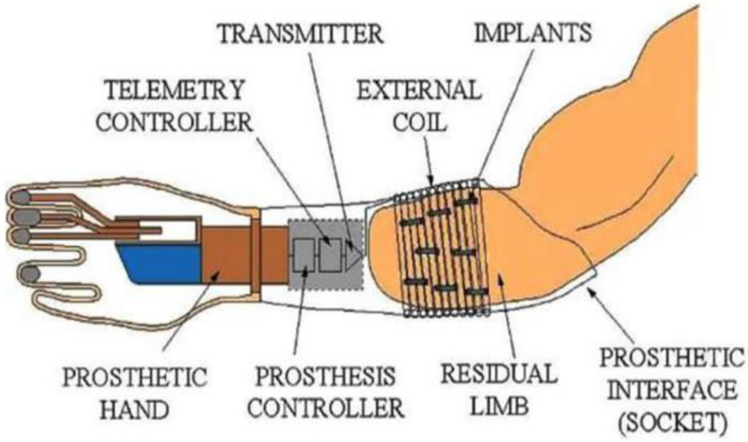

Figure 3. Schematic bioelectric of hand prosthesis

After the signal has been registered, it enters the processor, where it is processed. After this, the servos are activated, and the prosthesis makes some movement.

Because we can program the movement of the servos, we can define many different types of grips for the prosthesis. Traction methods, say, just clench and unclench your hand, when myoelectric prostheses are able to gesture, rotate the wrist, etc. On average, multi-grip prosthetics have a grip range of 18 to 22.

Conclusions

As can be seen from the information presented above, modern prosthetic technologies are far from ideal. Moreover, a person who has lost a limb, even after successful rehabilitation, will experience great difficulty wearing a prosthesis in everyday life due to imperfect fastenings.

To solve the previously mentioned problems, we decided to develop an electronic device. The basic idea is to utilize the effect of electrical potentials on the tissue at the prosthesis attachment points. We expect to gain new scientific information, reduce the risk of blood clots and reduce the effects of prosthesis pressure on the user's tissues.

Summarizing all of the above, work on this topic is in demand in the modern global prosthetics market.

Moreover, research in this area is already very relevant in the Ukrainian prosthetics market, and over time the need for a fresh look at prosthetics and the comfort of the injured person will increase.

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