

# **Prosthetics is a way of solving a limb-loss disease and the future of usage them in the structure of a human body.**

Matvey Burlakov, form 9, MBEI Academic Lyceum

Supervisor: Razencova Tatyana Petrovna

Prosthetics is a way of solving a limb-loss disease and the future of usage them in the structure of a human body.

**The purpose** of my reseach is to prove the actuality of using the artificial limbs.

**My tasks are:**

- 1) to find out what is a prosthetic limb,
- 2) to study the history of prosthetic,
- 3) to learn about people who had suffered a limb-loss event
- 4) to investigate the advantages and disadvantages of artificial limbs,
- 5) to try to define the possible future of prosthetics.

**Actuality:** The limb-loss event was experienced by humans in all times, and as a result of people's desire to solve these problems, the prosthetic limbs and artificial inner organs were introduced.

Prosthesis is an artificial limb, created to replace and imitate a missing or heavily damaged body part and its functions. We're going to talk about all this stuff a bit later.

**History.** The first prosthetic body parts were created by ancient Egyptians using fabric, lether and wood. Most of these were created and worn for a sence of "wholeness". But as you can see, this artificial toe appers to be pretty functional. During the Dark Ages tradesman and armorers were designing and constructing artificial upper- and lower-limbs using many gears, pulleys, clamps and springs for knights. The U.S. Civil War has forced Americans to enter the field of prosthetics, as the number of amputations rose astronomically. This is what beleved to be the "Hanger's Limb", a below-knee prosthetic. And lastly, this piece of artwork dates from 1840's to 1910's. The top joint of the wrist allows a degree of rotation and an up-and-down motion. The fingers can also curl up and straighten out. It is stored in the London's Sciece Museum. That's all for the history of artificial limbs. Now we're going to have a look in the modern days.

**Loosing a limb.** No one is protected from loosing a limb or two. Limb-loss can be caused by many things, such as diabetes, cancer, arterial disease, trauma, gangrene or birth defects. Many victims of traffic accidents or war actions are supposed to undergo the amputation procedure.

**Living without some parts of the body.** Losing a limb has a really strong influence on person's life and makes it very tough: A lot of tasks are becoming nearly impossible, and sadness, anger and frustration are common in these times.

**Statistics.** There are about 1.000.000 amputations performed each year worldwide that means that every 30 seconds someone is supposed to lose a limb. 58% of all amputations is caused by diabetes and arterial disease. 45% is caused by injuries. The rest of these things are caused by cancer and birth defects. The International Diabetes Federation predicts that global prevalence of diabetes will double from 285 million to 435 million by 2050 which will lead to increasing the number of annual amputations. All these facts are leading us to the conclusion that the invention of prosthetic limbs is necessary for mankind to survive. As Hugh Herr, the well-known prosthetics innovator said: "Maybe the next step in human evolution is not biological but technological". No need to worry, that only means that we will be able to cure another kind of disease no more. So, let's look at the one of several solutions of limb-loss.

**Types of modern artificial body parts:** 1) Body-driven, 2) Bionic, 3) Cosmetic/

Now we're going to take a quick look at each type and define their own advantages and disadvantages.

### 1. The **body-driven prosthetic limb.**

A good example of body-driven prosthetic is a set of artificial fingers developed by Naked Prosthetics. Coming in many sizes and shapes and created out of stainless-steel, titanium and silicone the **MCPDriver** is the best solution for individuals with **metacarpophalangeal** joint amputation. It is being operated via remaining parts of damaged fingers which makes it easy to take-off, change and clean. The main advantage of this wearable device is that it is able to operate with users strength. The main disadvantage, however, is that you are not able to feel anything with fingers like these.

Here's another variation called **PIPDriver**(For Proximal **Interphalangeal** Joint Amputation)

### 2. Now we're moving onto the **bionic limbs:**

This is Johnny Matheny and he wears the world's most advanced prototype of a bionic arm. But what's so special about this thing? Well, as all bionic limbs it is being operated not via physical interaction with the remaining joints but using the user's mind it can almost fully restore functions of the lost arm. It also has over 200 sensors that can provide the restoration of a senses by sending the signals back to the individual's brain. (show the control sensors) These are the sensors that are picking up a signals from Johnny's remaining nerve-endings and sending them to the arm's processor. It acts as some kind of a bridge between flesh and machine.

**So, the advantages of this thing are:** restoration of lost limb's functions and strength, ability to “feel” the new limb, high level of customization for user's needs.

**The disadvantages are:** it requires charging, as all electronic devices, it is vulnerable to the electro-magnetic pulses, sometimes requires reinnervation operation on user's side, a pretty complex structure which makes it very expensive (Thousands of hundreds of \$). The same goes for the lower-limb bionic prosthetics. **(Before slide: Alright, the following picture contains half-censored view of a person with a missing part of the face. Please, make sure to close your eyes if this kind of content is inappropriate for you).**

This is an example of a cosmetic prosthesis. As some of you can see, its main purpose is to restore the user's look, but not sight. (Show them magnets) These are the magnets that are used to attach the prosthesis to the face. This type of prosthesis does almost not require any maintenance but has no practical use – that's why it is called cosmetic.

Now, let's set the main advantages and disadvantages of using artificial limbs instead of organic or missing ones:

**The advantages are the following:**

- 1.The main advantage of any prosthetic is that it can help disabled people return to the normal way of life and rehabilitate,
- 2.The prosthetic limbs are not affected by biological illnesses,
- 3.Can be repaired and customized for each individual's needs.

**The Disadvantages are:**

- 1.Cost : a typical prosthetic limb can cost from 6.000 – 90.000 \$ due to the cost of used materials, performed researches and stuff involved in the development process.
- 2.Accessibility : not every country has the access to advanced artificial limbs technology.
- 3.Prosthetics are not able to restore blood cell circulation and regeneration.

**Possible problems.**

As the artificial limbs technology will continue to develop further, a new set of laws would be required to prevent the installation of artificial limbs by people, who have no need for this. You see, there's always will be those, who think that

use of strong artificial limbs instead of their weak organic ones will make them better at something (at drawing or dancing, for example). That's not true of course. These things require skill that prosthetics will never provide to you.

**Developing laboratories:** Here's several labs that develop world's most advanced prosthetics:

- 1) **Open Bionics** – known for their 3D printed low-cost bionic arms that are able to grow with user.
- 2) **Ottobock** – develops the world's most advanced lower-limb prosthetics for sportsman and common folk.
- 3) **BeBionic** – develops the world's most advanced arm prosthetics and the first ones to start researching artificial-nerve technology in their experimental devices.
- 4) **Naked Prosthetics** – The developers of body-driven artificial fingers. //

**The future usage of artificial body parts.** As you can see, the technology of prosthetics continues to rapidly develop and in short time people with limb-loss will be able to live a normal life again and will not be called “disabled” anymore. The limb-loss won't be cured but solved.

**The results of the research:** In the course of our research we solved the following tasks:

1. We found out the information about current types of prosthetics, their history and limb-loss event statistics.
2. We analyzed the advantages and disadvantages of using prosthetics.
3. We proved that the future use of prosthetics is imminent.

**Conclusion:** The wide use of prosthetic limbs is a key to help people who had suffered the limb-loss event return to the normal life. As the number of annual amputations will only grow, the further development of that kind of technology will be required. They have their own advantages and disadvantages and our society will need to adopt to the new rules of medical treatment.

**References:**

1. [AdvancedAmputees.com](http://AdvancedAmputees.com)
2. [ApmuteeCoalition.org](http://ApmuteeCoalition.org)
3. [ASSH.org](http://ASSH.org)
4. [Bebionic.com](http://Bebionic.com)
5. [Medscape.com](http://Medscape.com)
6. [medlineplus.gov](http://medlineplus.gov)

7. Paul Willy Moxey's summarization of global reseaches and his comments on ResearchGate.net
8. NakedProsthetics.com
9. Ottobock.org.
10. Wikipedia.org.
11. idf.org