A CHRISTIAN PERSPECTIVE ON GENETIC MANIPULATIONS

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Abstract: *Christians all around the world have many different questions about genetic manipulation. Moral discernment is variable and there is a wide range of differentials that scares people. We think that if someone wants to give explanation why is something wrong, or right, this person must have a lot of knowledge to support his/her arguments. People are mostly afraid today because they are not familiar with how fast the progress of the medicine is and what effects that has on Christians today. Are we always happy when medicine makes a new step? Science, ethics and theology can reward each other and make their dialogue fruitful towards the same goal, the humanisation. That is why genetics must be considered from different angles and we will try to present these in the following.*

Keywords: genetics, genetic manipulations, PGD, Orthodox Church, human dignity.

Genetic-γενετικὸς *genetikos* meaning *„genitive"/„generative"*, which in turn derives from γένεσις *genesis* meaning „origin'.[1]

Genetics is the study of heredity. Heredity is a biological process where a parent passes certain genes onto their children or offspring. Every child inherits genes from both of their biological parents and these genes in turn express specific traits. Some of these traits may be physical, for example hair and eye color, skin color etc. On the other hand, some genes may also carry the predisposition for certain diseases and disorders that may be passed on from parents to their offspring. In addition, it is not only about the human being, but also about variations in similar or related animals and plants.

If we are speaking about genetics, we need to mention some basic elements for easier understanding.

Chromosome is a structure that is thread-shaped, made up of DNA that occurs within the cell nucleus as a microscopic unit. Chromosomes are usually in pairs and the number is different from species to species. *„For human beings it is normal to have twenty-three pairs. One in each pair comes from each parent. Twenty-two pairs are essentially alike in both*

[1] Henry George Liddell, Robert Scott, *A Greek-English Lexicon*, Perseus Digital Library, Tufts University, 2012.http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.04.0057%3Aentry%3D%2321880&redirect=true (access 15.06.2016).

males and females and are called „autosomes". The twenty-third pair determines sex and hence is distinguished in the male (XY) and female (XX)".[2]

Gene is a segment of DNA that we can find as a structural part of chromosomes and codes for the production of the inherited traits and characteristics. Genes can determine many things that are transmitted from parent to child, like the skeleton, organs or mental characteristics. Genes are also in the pairs, and on single chromosomes, we can find many genes. *„It is estimated that as many as 30 000 genes exist in each human cell nucleus. If chromosomes are imagined as strings of bread, then the genes would be the bread".*[3]

„An allele is one of two or more alternative forms of a gene that occupy the same position on homologous chromosomes".[4]

Genes contain direction that instructs body's cell structures, hormones and enzymes. They are known as *„building blocks of life"* because they direct the body's production of chemicals necessary for life. Dominant gene is when an allele expresses a characteristic and it is the only gene in the pair. Recessive gene is when both genes in the pair must be in that form to express the trait.

Genetic material has the possibility to change. This is called mutation. A mutation can be the result of a number of different causes, it can be inherited or maybe the product of environment (radiation). Mutation can produce defects and these defects are caused by recessive or dominant alleles. Of course, if it is a case of recessive allele, the child must inherit the defective gene from both mother and father (this is the case, for instance, with cystic fibrosis).

Some anomalies are not only the result of a mutation of genes, but a chromosomal defect. There are problems with extra chromosome, that are responsible for the Down syndrome, or lack of autosome, where individuals do not survive birth. There area lso problems when a sex chromosome is missing (Turner's syndrome-XO), or an extra sex chromosome is present (Klinefelter's syndrome-XXY). In the cases of sex chromosomes, the baby will survive, but certainly, there will be some deviant symptoms.

Genes are studied by scientists also because they can now determine predisposition of an individual to the disease. What is possible for people to inherit?

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[2] Richard J. Devine, *Good care, painful choices: Medical Ethics For Ordinary People,* 3rd ed., Paulist Press, 2004, p. 125.
[3] *Ibidem,* p.126.
[4] *Ibidem.*

Human Genome project

„The Human Genome Project was a 13-year-long, publicly funded project initiated in 1990 with the objective of determining the DNA sequence of the entire euchromatin human genome within 15 years. In its early days, the Human Genome Project was met with skepticism by many people, including scientists and nonscientists alike".[5] The human genome project developed radically new reproductive techniques and possibilities to alter human nature, so we are faced with moral and ethical challenges that both fascinate and terrify.

Homo Sapiens-whom Scripture identifies with Adam, person created in the image of God, with possibilities to attain the divine likeness today is almost replaced with Homo scientificus.[6] This is the product of the new age. The things that humans could only dream about and that we saw in science-fiction movies, today is a reality.

The human genome project established goal, identified and mapped of all the estimated 30, 000 genes in human genome. During the first years of the project, scientists strived to identify genes, but not to sequence them. However, they announced in 1993 reidentity of the genes which are responsible for such genetic diseases as amyotrophic lateral sclerosis (ALS), adrenoleukoduystrophy (ALD) and type II diabetes. During this project, there were many questions from different perspectives. People were concerned and afraid of such a rapid moving. That is the reason why a special program-the Ethical Legal and Social Implications Program (ELSI) was established, in 1992.[7]

Genetic Screening and Detection

Genetic screening can be done on the fetus, about what we will have more words later, or on the parent(s) with different objectives in mind. If the screening is done on the adults, the aim is to be sure regarding reproductive decisions or to test on the late onset disease like Huntington's disease. In the care of fetus, parents are asking for it, because they can be uncertain about continuing the pregnancy because of the risk of some genetic anomaly. Genetic screening is not possible and not desirable for all. There must be some suspicion.

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[5] Heidi Chial, „DNAsequencing technologies key to the Human Genome Project", in *Nature Education,* I (2008), no. 1, p. 219.

[6] John Breck, Lyn Breck, *Stages on Life's Way: Orthodox Thinking on Bioethics* Crestwood, New York, St. Vladimir's Seminary Press, 2005, p. 34.

[7] Richard J. Devine, *Good care, painful choices: Medical Ethics For Ordinary People,* p. 128.

There are four classes of individuals that are usually identified as most at risk, prime candidates for genetic testing are the following: *„When a family history shows examples of a genetic defect in successive generations, the present generation will surely need to be concerned about its genetic inheritance"*.[8]

Second situation will be in a family where a previous pregnancy produced a child with genetic disability.

Third situation will be racial and ethnic groups among whom particular genetic defects occur with some frequency.

Fetal testing is recommended for chromosomal abnormalities when a pregnant woman is over thirty-five.

Science developed various methods of testing, but we still do not have the possibility to cure any genetic anomaly. We have information and in some cases the possibility for treatment. Doctors and counselors have the obligation to give advice to parents and to help them to face with the diagnosis. After this information, the couple can decide with respect to the current or future pregnancy. This discernment is certainly a very sensitive one, and also entails high demands in professionalism for physicians as well as for counselors. Treatment is possible in some cases, as we already said. That is the case with PKU (Phenylketonuria) where the disease is caused when the child is unable to produce the enzyme needed to break down phenylalanine, an amino acid that can be found in milk. All newborns are now screened for PKU and it is possible to place infected infant on special diets that assures normal growth and development. The same is the case with compatibility/incompatibility of Rh factor.

Questions of ethical implication in the context of genetics have also evolved around equality. This kind of genetic screening is very expensive and it is not possible for everyone. The health care gap is obvious in this case. People are also questioning the matter of invasion of their privacy, as well as insurance companies will want to limit the risk. The question regarding the suspected intention of "perfect" children has increased. It is not only about prevention through abortion when genetic deviation are known in, but also through personal wishes of parents who want children with specific characteristics. It is not only a question about screening, but also about engineering.

We are questioning what will happen in future. What will happen to those children who *„slip through whatever genetic safety nets we construct?"*[9] For many people abortion is under consideration, when they find out

[8] *Ibidem,* p.129.
[9] *Ibidem,* p. 151.

that a genetic deviation is known. According to statistics, 95% of parents decide for abortion after they find out that the child will have the Down's syndrome. We need to reconsider, how people with disabilities are looking on this. They may understand themselves as a mistake, rather than as a surplus, in the context of such decisions, which are necessarily complex and subjective discernment processes. However, one can show with these examples how genetic testing and screening interviews both personal and societal ethical dimensions. Therefore, a careful public discourse needs to be led, in which the individual decisions are respected and protected.

PGD-Preimplantation Genetic Diagnosis

Preimplantation genetic diagnosis is understood as testing of embryos because of doubt on some genetic disease. Also, PGD is used in the cases where they need compatible tissue for the family in the case of sickness.[10] The process of PGD is very simple: one cell is taken away from the embryo the when embryo is in the eight-cell phase (that is usually the third day of growth). DNK is analyzed from allocated cell in order to determine the level of the risk of a genetic disease or extra genetic material. In practice, the biggest number of embryos tested is conceived with IVF. Then the couple can make a decision. They can choose which embryo they will put into womb. This process is called PGD with embryonic selection.

Advantages and disadvantages of PGD

The advantage of PGD is that it allows couples with a high probability of serious genetic disease to have a child who will be genetically theirs, but will not inherit the disease. Also, in the UK PGD is most frequently used in order to select a particular gender, in order to avoid diseases that are transmitted on the X chromosome and to check chromosomal disorders, such as Down syndrome. Cystic fibrosis is the most common disease that is tested by PGD.

PGD is inefficient with regard to the characteristics that vary according to two or more genes, however, more serious disorders with a

[10] Australian Government, „National Health and Medical Research Council", in*Ethical guidelines for the clinical practice of ART in Clinical Practise and Research,* (June 2007), p. 55. http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/e78.pdf (access 12.06.2016)

single gene could be easily discovered, and thus present the parents with the possibility of nonimplantation. PGD does not involve modification of the human genetic material. The disadvantage of PGD is that people are not paying attention to the treatment of the embryo, although there is diagnosis, but only on their removal. It is alleged that the implantation of such embryos into a woman increases the risk of miscarriage, and thus after the diagnosis of steam requires to make judgments about life or death of the embryo.[11]

In this way, a large number of people are connecting PGD with a new form of eugenics, as the number of people with genetic diseases in this way is reduced. Organizations of people with disabilities are particularly critical of PGD because of the lack of control of its application in many countries. Many doctors explained that this method of establishing a *„perfect society"* is the opposite of diversity in society who needs to support persons with disabilities. The Ethics Committee of the American Society for Reproductive Medicine concludes that PGD, which is used to check the diseases that manifest themselves only in adulthood are ethically justified, but it must be under the strict supervision of the Committee.[12]

When we talk about choosing gender during PGD, it should be exclusively for medical purposes. This attitude of the ethical committee of the American Society for Reproductive Medicine was presented in 1994. However, since then, more and more people are interested in IVF with no medical indication, but because of the possibility to choose gender. The report from 1994 stated that we should discourage the selection of embryos for a particular sex, because the launch of IVF with PGD for the only reason of child sex selection has a higher risk of unjustified gender issues and causes social harm and using medical terms for the wrong purposes.[13]

In May 2001, a new report was published which says that, if it is determined that the cell sorting is safe and effective; doctors should offer sex selection for couples. Couples should be the ones who are fully informed about the risks and failures, and to confirm that it will completely accept a child of the opposite sex, who were advised about

[11] Ivan Kešina, „Preimplantacijska dijagnostika-u službi selektivnog pobačaja prije trudnoće", in *Crkva u svetu* 36 (2001), no. 2, pp. 153-173.

[12] Ethics Committee of the American Society for Reproductive Medicine, „Use of preimplantation genetic diagnosis for serious adult onset conditions: a committee opinion", in *Fertility and Sterility* , 2013, vol.100, pp. 54-57.

[13] Selena Ewing, „Sex selection „approved" by the American Society for Reproductive Medicine", in *Bioethics Research Notes,* 13 (December 2001).

unrealistic expectations about the behavior of children of opposite chosen sex and offered them to participate in research on conservation, efficiency and demographics selection of the chosen gender.

Certainly, we must set boundaries, in which cases the sex selection is allowed and where it is not. Scientist Ewing argues that it is essential that medical ethics should be based on the consistent ethic of the Church, which is staunchly committed to protecting human life, claiming that regardless whether the child is healthy or not, he/she has personality.[14] PGD is quite an expensive process that requires 4-9 000 US dollars. Of course, the costs are not the only problem, but it is a problem, because this way the diagnosis is only available to certain couples. In the United States, about 9% of clinics allow choosing sex during PGD calling it *„family balancing"*. In these families, if a couple has more children who are of the same sex, they would choose to have another pregnancy only if they will be sure of the child's sex.

Genetic Engineering

Manipulations of genetic material of human beings had biological and social consequences that affect virtually everyone. Genetic engineering involves manipulations of genetic material (DNA) in the gametes or embryo for either therapeutic or eugenic purposes.[15]

Many questions have been raised in the first years when genetic engineering appeared. People were curious what kind of new life is possible to create in the laboratories and what consequences will that have on the future generations? Is it legal to patent living organisms? First experiments were on the animals, and then animal rights advocacy tried to protect them. We have almost the same picture today. Especially in the non-developing countries where there are no legal provisions to protect them. From the Church's point of view, in February 1987 the Congregation for the Doctrine of the Faith released its *Instruction on Respect for Human Life in Its Origin and on the Dignity of Procreation.* Each human being is unique and we need to respect that. Manipulations are contrary to the personal dignity, identity, and integrity. Also, the Church paid attention to some social aspects that may concern people, and that is who will have the possibility to treat his/her disease through genetic engineering. How expensive would that be?

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[14] *Ibidem.*

[15] Cf. John Breck, *The Sacred Gift Of Life: Orthodox Christianity and Bioethics,* Crestwood„ New York, St.Vladimir's Seminary Press, 2010, p. 190.

Therapeutic Genetic Engineering

Scientists after testing for genetic anomalies seek for possibilities to cure, and since the cause of the defect is in the genetic material itself, the only solution is to replace or rebuilt it. Today, we have possibilities for two ways of therapeutic genetic engineering. Those ways are different because of the use of different types of cells. The human organism has two kinds of cells: germ cells (reproductive cells) or somatic (non-reproductive cells). Each normal somatic cell in the nucleus contains 46 chromosomes (23 pairs). Germ cells contain 23 chromosomes, so that the union of sperm and ovum produces a combination of 46 chromosomes. Segments of DNA that determine the genetic code of inherited characteristic we can find in every chromosome that comprises some 100 000 genes. If we want to alter the genetic material of an organism, we need *„recombinant DNA"* (rDNA) or directly through *„transformation"* or through *„transduction"* which is viral transmission.[16]

Through recombinant DNA studies, scientists have achieved significant progress. They inserted genes into bacteria that now produce insulin, which can treat diabetes. President's Commission in the 1982 declared four steps required to achieve successful somatic-cell therapy:

Cloning of the normal gene.

Introduction of the cloned gene in a stable fashion into appropriate target cells by means of a vector.

Regulation of the production of the gene.

Ensuring that no harm comes to the host cells.[17]

In 1990 Dr. Anderson started gene therapy on a four-year-old child suffered from severe combined immunodeficiency (SCID) by introducing into her blood stream other cells that contain a copy of foreign gene. Dr Anderson first extracted T-cells from the child's own blood and exposed to a mouse-leukemia retrovirus. Retrovirus then acting as a vector, invaded the T-cells and incorporated its genetic material, including the missing gene. After that, followed the process of infusing reengineered T-cells back to the child's bloodstream, where the new gene began to produce the missing enzyme, so that the immune system started to recover. Dr. Anderson reported after few years that the child now has a healthy normal life. This therapy lasted for years, and the child needed to receive weekly injections of PEG-ADA, a drug that provides missing enzymes. After two years of gene therapy, the doctors

[16] *Ibidem,* p.191.

[17] Richard J. Devine, *Good care, painful choices: Medical Ethics For Ordinary People,* p. 132.

said that the child does not need to receive therapy anymore, because reengineered cells are now producing ADA enzyme.

Dr. Anderson said that gene therapy had not produced a cure, but claimed, *„if you put a correct gene into enough cells patient, you will correct the disease"*.[18] Today, any activity that involves therapeutic genetic engineering is experimental.

Pope John Paul II said about the legitimacy and criteria of strictly therapeutic interventions, whose aim is to heal chromosomal defects will, in principle, be considered desirable, provided they are conducted with the aim to the true promotion of the personal well-being of the individuals, without doing harm to his integrity or worsening his conditions of life. He declared that interventions like this would not harm the Christian moral tradition.[19]

The Orthodox Church in America in 2001 recognized the document entitled „Studies of embryonic stem cells in the perspective of Orthodox Christianity", in which it explicitly exposed the opinion of the Church. The document begins by explaining that the Orthodox believes that human life begins at fertilization and that the world is from the beginning.[20] Embryonic stem cells can be used for different purposes. On the one hand they can help in the research of infertility or early pregnancy loss. They can also be used in toxicological studies, regarding the effect of new drugs. The most important potential of these cells is their use in transplantation medicine, which can be used as a replacement cell therapy. In this way, it could help people who suffer from diseases that until now could not be cured. Such as diabetes, Parkinson's disease, multiple sclerosis, arthritis, stroke.[21] The American government has allowed research on embryonic stem cells, but this refers to the destroyed embryos that have no possibility of implantation. It further encourages researchers to use adult stem cells to achieve the therapeutic objectives set for embryonic stem cells. What is criticized in relation with such research is mainly the exploitation of the situation by the pharmaceutical industry and the doctors. The point is that these drugs,

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[18] *Ibidem,* p. 133.

[19] *Ibidem,* p. 147.

[20] Orthodox Church in America, „Embryonic Stem Cell Research in the Perspective of Orthodox Christianity", OCA Chancery NY, (October 17, 2001). https://oca.org/holy-synod/statements/holy-synod/embryonic-stem-cell-research-in-the-perspective-of-orthodox-christianity (access 17.06.2016)

[21] Guido de Wert, Christine Mummery, „Human embryonic stem cells: research, ethics and policy", in *Oxford Journals*, XVIII (2016), Issue 4, pp. 672-682. http://humrep.oxfordjournals.org/content/18/4/672.full (accessed 17.06.2016)

which are also questionable, will not be able to be accessible to everyone, but only to certain people who have the financial possibilities.

Eugenic Genetic engineering

When scientists are correcting genetic anomalies, they are doing only one possible way of recombinant DNA technology. There is also the opposite way, when scientists decide to modify the faulty genetic material at concept. Alternatively, even further if there is no defect at all. When this is happening, this can be called eugenic genetic engineering. Here we can make a connection with PDG for choosing sex. This is also a method without medical indication, there is nothing to cure, but the couple wants to know what sex will be their future child. They segregate X chromosome from Y. An egg can be artificially fertilized to produce the desired sex. Also, when the intervention has the aim to increase some desirable traits or characteristics it is named as *„enhancement genetic engineering"*, where the creation of an *„improved"* individual in a species or a new life form is termed *„eugenic genetic engineering"*.[22] Cloning involved in genetic manipulation and it's development created dramatically new dimensions to the discussion of the clinical applications of genetic science and of artificial reproduction. The idea of cloning evolved in history for some time, but it was hard to be implemented. The first famous case that shook the whole planet was the case of sheep Dolly in 1997. There were different theories on the best way for cloning, but Dr. Wilmut who cloned Dolly had a radically new idea. He called it procedure- somatic-cell nuclear transfer technology. Scientist took the nucleus from the six-year-old sheep's mammary cell and inserted it into an egg from another adult sheep that he had previously enucleated.[23] Then they applied electrical charge that caused the pores of the egg and cell to open, fusing the contents of two and they got an embryo. What may sound an easy procedure was the result of more than 250 attempts before they made it. There were many similar attempts, but what scared people was the idea of cloning people. The same doctor that succeeded in the cloning of Dolly at the end of the 20th century announced that he has the idea of cloning human beings. For the start maybe not the whole human beings, but to clone human embryos in order to withdraw them stem cells.

[22] Richard J. Devine, *Good care, painful choices: Medical Ethics For Ordinary People,* p. 134.
[23] *Ibidem.*

Stem cells attract big attention of scientists, biologists and theologians. There are a number of reasons. These cells have great potential for healing tissue, so that is the reason why many researchers perceive stem cells as a cell of the future. Also, they can replace defective cells. What is problematic and about what they are debating is that the human embryonic stem cell hES cells derived from human embryos before implantation. The UK is the first country that enacted a law regulating the use of human embryos for stem cell research. [24] Exploitation of stem cells to create chimeras-animals with tissues and organs produced from human stem cells is not ethical. If this would constitute the trend, it will come to a tragic devaluation of human life. Also, Holocaust is universally accepted principle that human experimentation can not be conducted without the permission of the subject. If we consider embryonic stem cells as the beginning of life, how we can get approval?

The main finding of the document that the Orthodox Church in America released is the information that has been proven to be found in adult stem cells, and bearing such great potential, can be said very similar potential with regard to embryonic stem cells, and therefore it is absurd to use the embryonic stem cells. It appeals to the believers not to do evil, citing the Apostle Paul: *„Why not say-as some slanderously claim that we say. Let us do evil that good may result? Their condemnation is just!"* (Rom. 3:8).

Understanding of human dignity in Christianity

Understanding of human dignity in Christianity is truly revolutionary. It is believed that every human is worthy as it is created in the image and likeness of God. This clearly alludes that every human possesses dignity. Human therefore does not have its own dignity, but God gives him/her dignity and it is the fruit of God's mercy. The human dignity of the image and likeness of God consists precisely in the likeness of God himself. Although human was created in the image of God, due to the ancestral sin, he loses dignity, and the Lord Jesus Christ is the one who becomes the redeemer of humankind and that restores dignity.[25] Christian theologians are connecting the idea of dignity with the understanding of human as rational being. Intellect is what makes a

[24] Cf. Guido de Wert, Christine Mummery, „Human embryonic stem cells: research, ethics and policy".

[25] Cf. Luka Tomašević, „Teološki pogledi na dostojanstvo ljudske osobe", in *Kačić*, *Split*, 41-43 (2010), pp. 1165-1195.

human-a human and able to live morally, according to this human is a unique and unrepeatable being that has its own dignity and, therefore, God may give to human the answer for its reasonableness and morality of his life. The dignity of the human person is not infringed when a human being loses his/her intellectual abilities and physical characteristics. Thus, every person, regardless of differences must be respected, even when he/she seemingly loses his/her dignity, either physically or morally. Therefore, as time passes, there was a development of personal dignity, which corresponds with Christian ethical principles. Interpersonal relationship corresponds with the biblical relationship between human and God, who is the Creator. Human was created as an icon of God as a free being invited to co-existence with God. The Incarnation of Christ is the greatest testimony of the dignity and human values. Some theologians of the late twentieth century developed the idea that human can force their morality to curb the instincts and that is the reason that elevates human in relation to other creatures.

Genetic research can be a great contribution to the human race, if one uses it in accordance with God's will, to preserve and develop the created world. It can also be a danger, if it is used in order to adjust our selfishness.

There is only a small step between genome that can remove diseases by way of research and creation of artificial organisms that can destroy wildlife.

The separation of therapeutic and non-therapeutic intervention on the human body is very hard and demanding, especially if the body is seen as a psycho-physical corpus. The body of Christ, which is the Church, should be seen as a hermeneutical key of interpretation of the body and because the characteristics of the Church can provide criteria for differentiation allowed unauthorized forms of genetic intervention.