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Editorial

Is CRISPR a fear Against Sports?

Dear Editor

One of the most worrying applications of molecular technology in sport is the gene doping, which is an outgrowth of gene therapy. In gene therapy, the missing or out- functioned gene or gene fragment is replaced with the functioning one, by the help of transfectionable devices such as viruses. In gene doping, the interested region is mostly the genetic material for enhancing athletic capacity. World Anti- doping Agency defined gene doping as the "nontherapeutic use of cells, genes, genetic elements, or modulation of gene expression, having the capacity to enhance performance". To date, different researchers have attempted to inject different types of genes to model organisms [1,2], but still these approaches are far from safeness in humans, even in medical area.

A new gene editing strategy gives promise for genome editing. Many scientists have now an opportunity to edit an organism genome by clustered, regularly interspaced, short palindromic repeat (CRISPR) technology. By this technology, with the help of RNA-guided nucleases, such as CRISPR Associated Protein 9 (Cas9), it is possible to modify endogenous genes by using a modified CRISPR-Cas9 system. This modified system will not only spur the development of novel molecular therapeutics for medication of diseases, but also perform targeted, highly efficient alterations of genome sequence and gene expression [3].

The CRISPR/Cas system is a natural prokaryotic acquired immune system that are used against some plasmids and phages [4]. This system is found nearly 40% of sequenced bacterial genomes and 90% of sequenced archaea, and shows sequence similarities [5]. This system's potential to recognize, metabolize and edit the foreign DNA and RNA let scientists to consider the application of this system to human cell lines gör therapeutical reasons. Briefly, site directed enzymes recognizes the genomic region, and operate the editing process in the genome, without giving any damage to the genome metabolism. To date, several laboratories announced their ongoing research to apply CRISPR to human embryos for medical purposes [6]. to treat genetic diseases. Liang et al. (2015) reported the first results of applying this methodology to non-viable human embryos for repairing a mutation responsible for a heritable genetic disorder, beta thalassemia. The oncologist, Lu You, from Sichuan University in China, applied this technique to the isolated immune cells of a patient with aggressive lung cancer, and these modified cells were delivered back to the patient to fight against cancer cells [7]. By the end of 2017, scientists hope to start clinical trials using CRISPR-Cas9 against different types of diseases, after the completion of funding or needed approvals.

Sport genomic is branch of science that deals with the genetic endowment of athletes. It investigates the genetic predisposition to exercise, non-contact injuries like tendonopathies, stress conditions effecting athletic performance and nutrigenomic biomarkers in sports. Most single nucleotide polymorphisms (SNPs) have effects on gene regulation, and therefore have effects on athletic performance. To date, upto 250 SNPs are considered to be related with athletic performance [8]. Having information about these SNPs now let us to give optimal advice for training, or for nutritional approaches. For example one of the gene coding for actin proteins in muscles is alpha-actinin-3 (ACTN3). The common form, wild type, of this gene is expressed in fast switching muscles fibers, allowing athletes to have a more power phenotype [9]. A polymorphism within the gene (C>T transition) alter the amino acid number by a non-sense mutation, and protein structure. Arginine (R) amino acid changes to a stop codon (X) at position 577. Polymorphic variant makes the muscles to have more endurance phenotype. Like in this example, with the help of CRISPR-Cas9 strategy, it will be possible for cheaters to edit an athlete's genome for endurance, or power phenotypes, by giving a way to C or T allele in the interested region. Not only in *ACTN3*, but also the genes responsible for endurance phenotype, like *MCT1*, *IL6*, *PPAR-alpha*, *MSTN*, will be all in the scope of gene dopers. And

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this scientific, but not in sports spirit, approaches will be the worrying barrier in front of sports. As f today, this technology cannot complete its evolution in the terms of gene therapy, and this seems to be the most important limitation against the applicability. Against these, new strategies should be developed for detecting CRISPR- edited genomes, although it is a little bit difficult. But no need to say, the ones who "Dope for hope" by using this technology will be under stress all over their life, because of the fact that there will be the time that detectable diagnostic approaches will be ready to be used. They also will have the same penalties like chemical dopers, or blood dopers after being detected.

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