Steroid effects can last decades

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Even a brief intake of anabolic steroids can have long-lasting performance enhancing effects, new study reveals. The effect can, in principle, last decades, argues professor.

The use of illegal muscle-enhancing substances is a clandestine activity in many sports ranging from weight lifting to cycling.

This is why top athletes are regularly controlled, and when an athlete is caught doping, he or she can risk being handed a penalty of up to two years.

However, a new Norwegian study, published in *the Journal of Psysiology* [7], suggests that this penalty is too lenient. The findings show that mice that had been exposed to anabolic steroids for two weeks still experienced rapid muscle growth even three months after withdrawing the intake.

Muscle mass grew by 30 percent

A research team at Oslo University, headed by Professor Kristian Gundersen, exposed the mice to anabolic steroids for two weeks, which resulted in increased muscle mass and an increase in the number of nuclei in the muscle fibres.

The drug was then withdrawn for three months, a period which corresponds to around 15 percent of a mouse's lifespan. After the withdrawal, the mice’s muscle mass grew by 30 percent in six days following load exercise, while untreated mice showed insignificant muscle growth during the same period.

This suggests that the steroids still had a clear effect on the muscles in the first group even after a long period with no steroid use.

Muscle memory

The mechanism behind this effect can be described as a form of ‘muscle memory’, where an increased number of nuclei in muscle cells is maintained after temporary use of performance enhancing drugs.

Each nucleus can produce proteins for a certain volume of the cell. Thus, each nucleus and the associated synthetic apparatus can be viewed as a small protein factory that builds muscles. In principle, the more nuclei, the bigger muscles you can obtain.

“There is an accumulation of nuclei when you build muscles, and these nuclei seem to promote the gain of muscle mass with future exercise,” Gundersen says in an article on the Oslo University website [8].

“Nuclei accumulation gets harder as you get older. Therefore, it may be advantageous to perform overload exercise at a young age in order to counteract frailty in the elderly. Such frailty is an important health issue in the ageing population of Western societies.”

From mice to men

Even though the study was completed on mice, it is likely that comparable mechanisms are involved in human cells as basal biological mechanisms are often alike in mammals.

“The specific time aspect is of course challenging to extrapolate from mice with a lifespan of two years to humans, who live for 80 years. However, the cell nuclei in humans are known to be very stable,” says the professor.
“If the muscle memory mechanism in humans is similar to what we observe in mice we could be talking about several decades of advantageous effects.”

Change of maximum exclusion penalty?

It is primarily in explosive sports such as discos, weight lifting and sprint that the effects of steroid use and muscle memory will be advantageous.

The new findings may spark a new debate on the exclusion rules set by the World Anti-Doping Agency (WADA).

The WADA today operates with a maximum exclusion penalty of two years for athletes testing positive to performance-enhancing drugs. This may be changed to four years in 2015. The question, however, is whether this will be enough:

“If the effect of steroids are permanent, shouldn't the exclusion be permanent as well?” asks Gundersen.

Read the Danish version of this article at videnskab.dk [9]

The effects of anabolic steroids last much longer than the penalty given to athletes who are caught doping. (Photo: Shutterstock) [10]
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Fact box

Anabolic steroids, technically known as anabolic-androgenic steroids (AAS), are drugs that are structurally related to the cyclic steroid ring system and have similar effects to testosterone in the body. They increase protein within cells, especially in skeletal muscles.

Anabolic steroids also have androgenic and virilising properties, including the development and maintenance of masculine characteristics such as the growth of the vocal cords, testicles (primary sexual characteristics) and body hair (secondary sexual characteristics).

Source: Wikipedia

The specific time aspect is of course challenging to extrapolate from mice with a lifespan of two years to humans, who live for 80 years. However, the cell nuclei in humans are known to be very stable. If the muscle memory mechanism in humans is similar to what we observe in mice we could be talking about several decades of advantageous effects.
Kristian Gundersen

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"A cellular memory mechanism aids overload hypertrophy in muscle long after an episodic exposure to anabolic steroids", Physiology, DOI: 10.1113/jphysiol.2013.264457 [7]

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