



Research Article

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## Study on recovery of sports injure of football player based on gene therapy

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### ABSTRACT

*Sports injure can affect the training effect and performance of football players, therefore it is necessary to find out an effective treatment for it, the application of gene therapy on treating the sports injure of football players is studied in depth. First, the common sport injures of football player are summarized. Second, the reasons of football sports injure are analyzed. Thirdly, the basic idea of gene therapy is described. Then experimental analysis is carried out for 120 cases of football sports injure, and results show that the gene therapy can get better treating effect than traditional treatment.*

**Key words:** Sports Injure; football player; gene therapy

### INTRODUCTION

With the improvement of competitive sports and athlete's physical fitness, the modern football showing characteristics of fierce confrontation, quickness, frequent transition and overall coordination, and so on, then the higher demand is put forward for the football player. The football player not only has the superb skill, but also has the strong physique and good physical fitness. In cases of increasing intensity of confrontation and training, the body and psychology of the football player bear huge pressure, therefore the sports injure of football players became increasingly common. The sports injure infects the training and match of football players seriously, and hold the level of the football players back, then the scientific training and normal match are difficult to be achieved, and shortens the movement life of football players, and causes the disability of football players, and brings the huge economic loss for the football players<sup>[1]</sup>.

It is necessary to find out an effective treatment for the sports injure of football players, the gene therapy is put forward from 1992. The pharmaceutical scientist Bandara used the retrovirus as the carrier, and moved the  $\beta$ -Galactosidase gene to Rabbit synovial cells cultured in vitro, and amplification cells are transferred to the knee joint of rabbit. In 1996 the first case of rheumatoid arthrit is treated by gene therapy. In recent years, the gene therapy has been extended to the treatment of sports injure. It is feasible to treat the sports injure of football players based on gene therapy<sup>[2]</sup>.

#### Common sport injure of football players

The football movement is one of sports events with high incidence of injures, lightest injure is bruises, the heavier injures conclude fracture, dislocation and rupture of viscera. According to the related statistics, 48% of football sports injures is light, 19% of football sports injures is medium, and only 3% of football sports injure is heavy. And 86% of football sports injure happens in limbs. Except for bruise and contusion, ankle joint sprain is most common, secondly muscle strain of before and after of thigh happens often. The knee joint injure s is next. Although dilacerations of meniscus, fracture of cruciate ligament, fracture of patella, and chondromalacia patellae are relatively rare. Once that happens, it is difficult to treat it. Goalkeeper often falls for deflecting ball, therefore injures of hand wrist and elbows are prone to infrequent<sup>[3,4]</sup>.

### Reasons of football sports injure

#### (1) Sports injure in the football match

The fierce competition, sprint and tackle during the football game are prone to muscle strain and fracture of thigh and calf. Sudden change of position and abrupt adduction of calf can lead to injures of ligament and bone of knee and ankle joints. For example, the football player is injured by football during the procession of match, most typical injure is injury of finger for the goalkeeper, such as ligament and subluxation of joint for thumb, index finger and other fingers. The calf and thigh are often kit by the boots, knee and calf of the other side, which can lead to the muscle contusion, ecchymoma, and muscular rupture and injure of bones. During the match, scrimmage, bump and football players and sprint of football can make the player fall easily. Therefore the incidence of injures is big, when the football field is uneven injures can happen easily. If the football player falls on the plastic lawn, they will get thermal burn.

The reasons of existing injures mentioned above conclude the following factors. The main reasons are the incorrect movement and technology of football players. The next reasons are that the football field is not good, and the football player ignores the use of protective equipment, the referee is not strict and the football player is overworked [5].

#### (2) Unscientific training of football players

The football players have the temerity to carry out training, and have emotional impatience, and are anxious for success, then they ignore the principles of advancing gradually in due order and act according to theirs ability. The football players neglect the training on thought and relax, these factors are the main reasons of leading to injures.

##### (a) Insufficient preparations

No preparations or insufficient preparations are the other main reasons leading to the sports injure. If the football players do not preparations well, they get into nervous match or training, excitabilities of them are low, and is slow to the big stimulation. Therefore the strength of muscle and ligament is little, and the extensibility is not enough, the activity levels of joints are not big, the coordination of them is poor. In this case the pulled muscle and joint sprain can happen easily. The imaginary movement has a certain gap with the actual physical status, the demand exceeds supply, the sports injure is hard to be avoided. In addition, the preparations only focus on active exercise of some main parts, and ignore the activity of other joints, this is another main reasons leading to the sports injure.

##### (b) Fatigue period

The football players have not proper rest after they do heavy stress training or match with long time, however they continue to take vigorous exercise, this moment all aspects of functions of their body have fallen sharply. Because of long time movement, the perspiration is many, and loss of moist is more, the total salt concentration emitting from sweat is big. The water loss can lead to the decreasing of athletic ability. If the supplement moisture content and electrolyte such as  $K^+$ ,  $Na^+$  can not be got, the electrolyte in the body disturbances, the excitability of the muscle will increase, and the muscle will appear muscle spasms. At the same time, hyperglycemia will be caused. During the stage of sleep, poor rest and recovering from illness and fatigue of football players, coordination of the body decreases obviously, and the vigorous exercise will cause the sport injure of football players.

##### (c) Football field

The movement field is uneven, and there is no mentally preparation, then the sprain of ankle and knee joints is likely to be caused. The clothes and footwear is not suit for the sports and health requirements, then the sports injure may be caused. When the football players exercise in summer with high temperature and moist, they are easy to produce the fatigue and heatstroke, and sweat a lot, which will affect the internal water and salt metabolism, the cramp and exhaustion are easy to be caused. At the same time, the inflexible muscle will reduce the endurance then bring the sports injure of football players [6,7].

### Basic idea of gene therapy

The advantages of gene therapy conclude the following aspects:

- (1) Some illness resulting from the defective gene can be treated through regulating the endogenous gene expression.
- (2) The biological activity of endogenous proteins synthesized is higher than the exogenous recombinant protein.
- (3) Higher substance concentration can be achieved partially, and can last long time.

There are also some disadvantages for the gene therapy. The safety of it can not be ensured, and it can not be controlled effectively. For example, the virus carrying the gene may be reproduced or activated. The intercalary gene may suddenly change, which cause the disorder of cells growth. The interest protein may be overexpressed or expressed erratically. And the unstable expression may be benefit for the treatment. A special promoter has been

studied by some scientists, which can regulate the start-up and shut of the implantation genetic, and can control the gene expression flexibly.

The application of gene therapy on the treatment of sports injury has been concerned by many scientists. Some genes such as IGF-1, BMP-2 and TGF- $\beta$  are transferred into the muscle and bone tissue, and positive treatment effect is obtained. Some gene information that can amend and affect the repair have been obtained for injury of muscle and ligament, the maximum barrier is how to obtain the effective and safe gene carrier, control the gene expression effectively, and maintain the stability and safety of the gene.

The gene delivery has two kinds of methods, which are direct and indirect transfections. The former is to put the treating gene deliver the relating tissues and organs directly or through carrier, and make the theoretical gene express the information, then supply the expression of some bioactive substances. This method has simple and convenient operation, and has small damage for organism, but it has some disadvantages, for example the carrier can be diluted or combined, directed and specific target cell has low efficiency, and it can not offer repaired seed cells, therefore it can be combined with other treatment. The indirect transfection is to carry out gene modification for target cell in vitro, and make it express the bioactivator with therapeutic effect, then the cells with gene modified can be transplanted into vivo, and make the cells hyperplasia in vivo to express the target gene. This method is complex, but the transgenic cell with high expressing ability can be screened in vitro, the Security checks can be carried out before the gene is replanted in vivo to avoid the recombination and replication of virus and the introduction of DNA compound, it can offer seed cells, which has an important significant meaning for treating the serious damage of cartilage<sup>[8]</sup>.

## EXPERIMENTAL SECTION

### (1) Materials and methods

General materials: 120 cases are used in this experiment, where there are 65 cases of female football players and there are 55 cases of male football players, the age range of the injured football players is [19, 28], the injury reasons of the football players are shown in table 1.

**Table 1 Causes of injury for basketball players**

Cause	Number
Incorrect movement and technology	23
Football field is not good	20
Use of protective equipment	19
Referee is not strict	15
Football player is overworked	14
Unscientific training of football players	16
Fatigue of football players	13

The injured parts and injured types of football players are shown in table 2 and table 3 respectively.

**Table 2 Injured parts of football players**

Injured part	Number
Ankle joint	35
Knee joint	30
Muscle and ligament of thigh	23
Muscle and ligament of calf	20
Pulled muscle	12

**Table 3 Injured types of football players**

Kinds of sports injury	Number
bruise	30
contusion	25
sprain	22
pull	18
strain	25

The whole cases are divided into two groups, which are observation group and control group respectively. Every group concludes 60 cases. The sex, age and injury of two groups have no obvious difference ( $p > 0.05$ ), therefore the researching objects can be comparable.

### (2) Treating methods

#### (a) The observation group

The injured football players in the observation group are treated by the traditional medication combining with acupuncture, time of therapy is a month.

(b) The control group,

The injured football players in the control group are treated by gene therapy, the following parts are carried out:

Choice of target genes: the target gene is obtained based on polymerase chain reaction, the bone morphogenetic protein gene is used as the target gene. This kind of gene can induce the bone marrow mesenchymal stem cells, and is differentiated into cartilage cells, which has the promoting effect of repairing the injure of arthroial cartilage, the treating time is a month.

Choice of target cell: the adipose-derived stem cell is used as the target cell in the experiment, which has the differentiation ability to chondrocytes. The adipose-derived stem cell is the pluripotent stem cell in adipose tissue that is differentiated into fat cell, cartilage cell and gegenbaur cell. At present the adipose-derived stem cell is widely distributed, and is drawn easily, and has little wound, and can get a large quantity of cells, therefore it is an ideal target cell.

Choice of carrier: the slow virus is used as carrier, which is formed through genetically modification of human immunodeficiency virus. The virulent gene of slow virus has been replaced by the exogenous gene, it belongs to pseudotype virus. The slow virus is a kind of retrovirus, which uses RNA as template in the cell, and is reversed into cDNA under the effect of the reverse transcriptase itself, then uses cDNA as template and is integrated in the chromosome of target cell, and is expressed continuously.

Choice of Transfection method: the transfection in vitro is used in the experiment, the carrier with the target gene is transferred into the cell cultured in vitro, and the transfected cell is implanted into the organism after amplification and differentiation of it through monodermic or three-dimensional culture, and grows unceasingly. This kind of method is complex, but it can ensure the safety of organism.

(3) Judging of treatment effect

The recover time and recover degree of the injured football players are used to judge the treatment effect, and the final score of treatment effect is shown in table 3.

**Table 3 Judgment standard of curative effect**

Level of treatment effect	Score
Extremely good	>85
Good	84-75
Average	74-50
Bad	<49

(4) Statistical method

The software SPSS13.0 is used to carry out data processing based on  $t$  inspection and  $\chi^2$  inspection, if the condition  $p < 0.05$  is satisfied, the data analysis has the statistical significant.

## RESULTS AND DISCUSSION

(1) Analysis results of recovery time of football players of control and observation groups

The analysis results of recovery time of football players in observation and control groups are shown in table 5. 41 injured football players of control group recover in a week, while 12 injured football players of observation group recovery in a week. Only 2 injured football players of control group recover over four weeks, while 23 injured football players of observation group recovery over four weeks. The recovery time of observation and control groups has obvious difference ( $p < 0.05$ ).

**Table 5 Comparison of recovery time of observation and control group**

Recovery time	Observation group	control group
Extremely good	12	41
Good	11	13
Average	13	4
Bad	23	2

(2) Analysis results of recovery degree of football players in observation and control groups

The score of joint function of observation group and control group is shown in table 4.

**Table 4 Score of joint function of observation and control group**

Grade	Observation group	control group
Extremely good	10	37
Good	14	11
Average	15	8
Bad	20	3

(3) Analysis results of the treatment effect of observation and control groups

The comparison results of the treatment effect of two groups are shown in table 6. 57.21% of injured football players in control group are completely healed, while only 25.12% of injured football players in observation group are completely healed. Only 3.88% of injured football players in control group were not recovered, 30.76% of injured football players in observation group is not recovered. The difference between two groups has obvious difference, therefore it has statistically significant ( $p < 0.05$ ).

**Table 6 Comparison of treatment effect of two groups (%)**

Treatment	Observation group	control group
Extremely good	25.12	57.21
Good	26.84	30.64
Average	17.28	8.27
Bad	30.76	3.88

According to the experimental results, the gene therapy can obtain the better treatment effect than traditional treatment. The gene therapy method has the following effect on treatment of sports injure.

(1) The gene therapy can promote the healing of bone fracture.

The undifferentiating mesenchymal cells can be stimulated to proliferate and differentiate by growth factor, the proliferation of the bone cell can be promoted. The osteogenesis procession in a membrane and the cartilage can be induced, then the bone fracture can recovery.

(2) The gene therapy can promote the repair of cartilage defect

Because the cartilage cell has the limited regenerative ability, then the cartilage defect of injured joint has difficulty in being repaired, growth factor of gene therapy that affects the joint cartilage plays an important role in regulating the proteoglycan metabolism, which can make proteoglycan denser and more elastic. This suits for the physiological characteristics of cartilage.

(3) The gene therapy can promote the repair of ligament and tendon

Injures of ligament and tendon are common for the football players, the repair capacity of them is poor, and induces the arthritis easily. The growth factor of gene therapy can improve the toughness and stiffness of ligament, they can promote the synthesising of I type collagen and the activity of scar fibroblast cells, and be benefit for the matrix synthesis.

## CONCLUSION

The incidence of sports injure is high for the football players, the degree of injury is also serious, the main parts conclude ankle joint, knee joint, thigh and foot, the main injured types conclude the sprain strain and contusion. The gene therapy can treat injure of football players effectively, and get the better treating effect. With the development of molecular biology and tissue engineering technology, the gene therapy can be applied in the treatment of sports injure of football players deeply.

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