

# Causes and preventive measures of knee injuries in table tennis players

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**Abstract.** Table tennis, as the national sport of China, is widely practiced throughout the country and takes a leading position in the international arena. With the rapid development of table tennis, many excellent athletes have emerged. Since athletes are under high load in training for a long time, sports injuries are almost unavoidable, especially knee injuries, which have the greatest impact on athletes. Therefore, correctly recognizing the causes of knee injuries and mastering the corresponding preventive measures is an important topic. In this paper, we take the literature method and mathematical statistics method as the main research method, combine the knowledge of sports training science and sports physiology to introduce the parts and degree of knee injuries, analyze the causes of knee injuries according to the characteristics of table tennis, and put forward relevant suggestions, so as to help athletes effectively avoid knee injuries, improve the level of competitiveness, and contribute to the development of China's table tennis industry.

**Keywords:** Causes, Prevention, Knee Injury, Table Tennis Players.

## 1. Introduction

Table tennis, as the national sport of China, has a large number of people participating in the country by virtue of its small range of space, high safety factor, and its own recreational and fitness functions, and many excellent table tennis players have appeared. However, many people think that table tennis is not as physically demanding as basketball or soccer, and that injuries are rare, which is wrong. Table tennis is characterized by speed, explosiveness and flexibility, and both professional and amateur players will inevitably suffer from different degrees of sports injuries. The knee joint is the largest and most complex joint in the human body. Once an injury occurs, it will have an inconvenient impact on the athlete's training, competition and daily life, and even bring lasting pain. Correctly recognizing the causes of knee injuries and preventing knee injuries is of great importance to table tennis players. Studies have shown that knee injuries account for a relatively large proportion of table tennis injuries, about 31% [1]. Therefore, this paper discusses the site and degree of knee injuries, summarizes the main factors of knee injuries, and discusses how to prevent knee injuries. In order to help table tennis players further recognize the importance of knee injuries, strengthen the protection of the knee joint to avoid injuries, so as to improve the overall level and competitive ability of table tennis players.

## 2. Current status of knee injuries in table tennis

In table tennis, the athlete always maintains a semi-squatting state in both the preparation part and the hitting part, so that the center of gravity may be lowered, which is more advantageous to face the switch of movement and change of pace when hitting the ball. Take the forehand attacking leg movement as an example, when the opponent comes to the table, the athlete grovels and the center of gravity is on the right foot, at this time, the knee joint of the right leg bears almost all the weight of the body. When striking the ball, the athlete's center of gravity from the right foot to the left foot at the same time to drive the waist and arm rapid rotation of the force to strike, the knee joint not only to withstand the weight of the whole body, but also non-stop twisting, flexion and extension, need to withstand greater pressure. According to research, when the flexion and extension angle of the knee joint is in the range of 30°-150°, the joint is in an unstable state, which leads to an increased risk of knee injury in table tennis [2].

### 2.1. Part of injury

A survey study, with 30 youth table tennis players from Heze City Sports School as the research object, utilized a variety of research methods to investigate the current status of sports injuries occurring in the athletes' knee joint area from the perspective of knee injury part and number of times. The results showed that the knee injury parts of table tennis players were roughly categorized into seven kinds, as shown in Table 1 [3].

**Table 1.** Investigation of knee injury parts of young table tennis players in Heze Sports Schools.

Knee injury part	Number of injuries (times)	Percentage (%)
meniscus (anatomy)	10	26.3
kneecap	7	18.4
medial collateral ligament (MCL)	7	18.4
lateral collateral ligament (LCL)	6	15.8
anterior cruciate ligament (ACL)	4	10.5
posterior cruciate ligament (anatomy)	2	7.9
other than	2	7.9

The reason for the distribution of knee injury parts in athletes lies in the competitive nature of table tennis. The main reason is that table tennis players will keep twisting, flexing and extending the knee joint in the process of competition or training, and if the action is not standardized or improperly exerted, it will lead to meniscus pressure in the knee joint, which will lead to meniscus injury. If the knee joint is often overly flexed and extended, and the long range of internal and external turning, the cartilage below the patella and the femur's response surface will collide for a long time, which will easily lead to patellar injury. Finally, the overall sports load of table tennis is on the large side, the stability of the knee joint is poor in flexion, and the ligaments are always in a state of tension, and sometimes too much force and excessive pulling will lead to different degrees of rupture of ligament fibers or their attachments.

### 2.2. Degree of injury

A study investigated, by reading the literature related to clinical medical science and sports medicine, the classification of sports injuries in accordance with the sports by severity of the incidence of motor injuries is categorized into three levels: mild, moderate and severe injuries. The investigated athletes in this study will choose the most serious injury experience to fill in the options according to their own situation, as shown in Table 2 [4]. Mild injuries are mild and do not affect the original training program. After the injury did not lose motor function, only a mild impact on motor function, a little rest can continue to exercise again. Moderate injury will affect the training program, there will be obvious pain in the injured area, and there is no loss of limb movement. Severe injuries may not train at all, the basic

loss of motor ability, the injured area has obvious swelling, bruising, pain unbearable, may also produce ligament rupture or tear, must promptly seek medical treatment, stop any training.

**Table 2.** Distribution of injury levels (N=58).

degree of injury	number of people	Percentage (%)
mildly	23	39
moderately	30	51
severe	5	10

According to the chart, half of the total number of athletes had suffered from moderate injuries, followed by 39% of mild injuries, while severe injuries, though serious, accounted for a small percentage. The repetitive friction on the joint area during table tennis-specific training can easily lead to knee joint fatigue, reducing knee joint function and the strength of the surrounding muscles. Joint injuries have a long duration, and if the injury is prolonged, the condition will worsen and may go from mild to moderate to severe. If the athlete lacks the knowledge of injury protection and neglects the preparatory activities before training and directly enters the high-intensity specialized training, due to the high muscle viscosity, the sudden force or repeated pulling will lead to muscle strains and other injuries.

### 3. Causes of knee injuries

#### 3.1. Training reasons

Training factors are important causes of knee injuries in athletes. Such as whether the training content is reasonable, whether the training load is scientific and reasonable, and if there is the preparatory activities before and after training.

The training content is generally formulated by the coaches, and most of the training process is carried out collectively, which is easy to ignore the individual differences of athletes and lack of training arrangements for individual athletes. If individual athletes have poor physical strength and can't keep up with the collective training intensity, then it is easy for sports injuries to occur, which is especially common in strength and technical training. Unreasonable training content, such as excessive training, lack of accuracy in movement practice, and inappropriate training methods can easily put athletes at risk of injury, especially for the knee joint, which bears almost half of the body's strength. This requires coaches to develop correct training content and training programs, consider individual differences, determine training cycles and target needs, and regularly monitor and evaluate training effects.

The characteristics of table tennis require that it be played under a certain exercise load, both in competition and in training. In the training process, the principle of gradual training is often neglected, and some high-intensity, overloaded, and large-volume training is done in a single-minded manner. These training will make the body more than the maximum exercise load it can withstand, will make the body for a long time in the state of exercise fatigue, not only need a long time to recover and will make the athlete body deterioration, affecting sensitivity, technical movements, greatly increasing the probability of sports injuries, knee injuries are also the same.

The pre-training preparatory activity component and post-training relaxation are also particularly critical. Preparatory activities are purposeful physical exercises to overcome the physiological inertia of the internal organs, shorten the time to enter the working state and prevent sports trauma. If the preparatory activities are not sufficient, the knee ligaments and muscle groups cannot be fully stretched out, and they cannot be adapted to the upcoming strenuous sports or competitions for a short period of time. Relaxation is an important step to help the muscles back to their normal state, which can restore the lactic acid built up in the exercise blood and muscles to the normal pre-training level and accelerate blood circulation. Failure to relax after training may result in muscle stiffness, cramping, strain, etc.

### 3.2. Psychological reasons

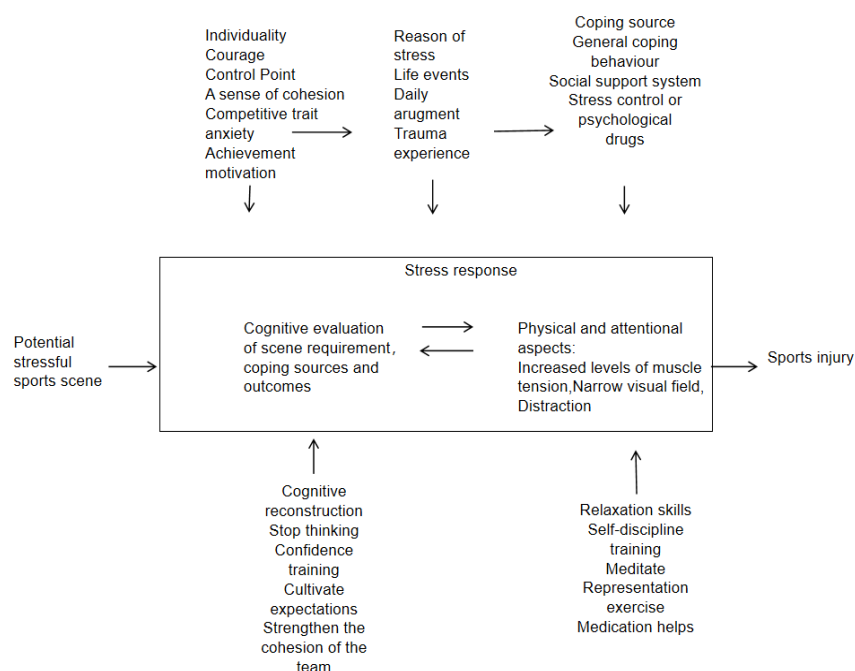
Table tennis is inextricably linked to the skill level and psychological quality of the athletes. Table tennis does not have the same intense physical confrontation as basketball and soccer and the probability of obvious trauma in the sport is very low, which makes the athletes' awareness of self-protection weak. If athletes are aware of sports injuries and the means to prevent them, they can effectively reduce the probability of knee injuries and better improve their sports level and ability. A study was conducted to investigate athletes' awareness of the importance and means of preventing sports injuries by using questionnaires, which were sent to table tennis club athletes, students who majored in sports and took table tennis, and amateur table tennis enthusiasts, with 70 questionnaires issued, 65 questionnaires recovered, and 93% validity rate of the questionnaires recovered, as shown in Table 3 [1].

**Table 3.** Athletes' Perception of Sports Injuries.

Cognitive situation	number of people	Percentage (%)
realise	4	6
general knowledge	54	83
I don't even know	7	11

According to the charts, athletes have the most knowledge about injury awareness in general, followed by no knowledge at all, which shows that athletes do not have a good understanding of injury awareness and means of prevention, and lack the necessary self-protection awareness in sports. A small injury and not give enough attention to continue training may make the injury more and more and finally become persistent. Or some athletes have injuries in the recovery period of the body has not fully recovered to continue to carry out high-intensity training, so that the injury site further deterioration of the condition of the cause of the career is cut short, the knee is also the same.

Early domestic scholars, Ji Liu, reviewed foreign research on psychological factors and sports injuries and summarized two factors closely related to injuries from the psychological level: personality and stress response [5]. Anderson et al. were the first to propose a model diagram of psychological stress and sports injuries, as shown in Figure 1.



**Figure 1.** Schematic diagram of the stress-exercise injury model [6].

Unique personality factors have correlation with sports injuries. Athletes with weak will are prone to show timidity, decadence and cowardice in the game, and produce negative emotions of nervousness and anxiety in the process of completing the movement, not daring to face opponents stronger than themselves and worrying about losing the game, thus affecting the play on the court and prone to error movements. The athletes who are overly aggressive have the strength of never giving up and the spirit of fighting in the process of the game, and may constantly try to break through their own limits, and are often get knee injuries when catching some scuffed tennis balls, and tolerate a higher degree of pain and neglect their own conditions when injuries occur in the training and competitions. Stress reaction is embodied in the performance of the occurrence of special events in life, such as when encountering emotional, family, life misfortune, athletes in the training and competition process cannot concentrate, produce agitation, pain, anxiety, at this time, the ability of self-control and the ability to protect the decline.

### *3.3. Other reasons*

Some of the other factors that may cause knee injuries include environmental factors, equipment and clothing factors, and equipment and venue factors. First of all, if table tennis is played in a particularly high temperature environment without air conditioning or other cooling measures, athletes can easily sweat profusely, resulting in heat stroke or dehydration, and the risk of injury can be high. On the other hand, if you train or play in a place where the temperature is particularly low and the preparatory activities are not sufficient, the athlete's muscles will be highly viscous, and the ligaments and muscle groups will not be able to stretch well, which will easily result in strains, especially for the knee joint, which is the joint that carries the largest amount of weight in the human body. Secondly, athletes should wear loose and breathable sportswear and professional sneakers. If the breathable effect of sportswear is poor or easy to stick to the body, resulting in sweat may not be effectively discharged, which can easily cause the athlete's sweat to their eyes and may not effectively complete the technical movements, exacerbating the risk of injury. Some scholars mentioned the effect of friction between table tennis shoes and the pitch on the knee joint biomechanical characteristics of table tennis players' stride movements in "The effect of friction coefficient between shoes and the pitch surface on the knee joint biomechanical characteristics of table tennis players' stride movements", and it was found that, the newer the table tennis player's shoes are, the higher the friction between shoes and the ground, and the higher the loading on the knee joint [7]. In addition, the equipment is an important indicator for judging sports injuries, athletes are generally familiar with the site in their own training has produced dependence and adaptation, when it comes to a new environment may be due to the site floor slippery, harsh light, high wear and tear of the ball table, blocking height inaccuracy, the audience, and other objective factors caused by the inability to accurately complete the technical action to play their own strength, increasing the risk of knee joint or other sports injuries.

## **4. Knee injury interventions**

### *4.1. Mild injury*

After mild knee injury, there is no loss of sports function, and the knee joint will have slight tolerable pain. At this time, it is necessary to rest and recuperate or fix the joint to maintain the stability of the injured tissues. If there is obvious swelling and pain, anti-inflammatory ointment or medicated water can be used, and local physical therapy can also be used to improve the blood circulation, eliminate the oedema caused by the injury, promote the repair of the injured tissues, and reduce the inflammatory reaction. After the mild injury, there should also be appropriate knee rehabilitation training to prevent muscle atrophy and venous thrombosis of the lower limbs.

### *4.2. Moderate injury*

Moderate knee injury will have obvious pain but not completely lose the function of movement, after the injury should be treated according to the RICE principle, Rest, Ice, Compression, Elevation, if the

condition is not very serious, it can be immobilized by the way of plaster, if the pain is more serious, it can be treated with drugs such as ibuprofen extended-release capsule to achieve the effect of anti-inflammation and pain relief as instructed by the doctor. If the pain is more serious, you can follow the doctor's instructions to use ibuprofen extended-release capsules and other drugs to achieve anti-inflammatory and pain-relieving effects. Do not use hot compresses, kneading and pressing for acute injuries (severe sprains or falls). Chronic injuries (the result of long-term accumulation of degenerative injuries) can be treated with hot compresses, physical therapy, acupuncture or massage, massage combined with non-steroidal anti-inflammatory drugs [8]. In addition to this it can also be improved by physical therapy modalities such as magnetic therapy and ultrasound physiotherapy.

#### *4.3. Severe injury*

the pain of the injured part is unbearable, the knee joint completely loses the function of movement, and even open injury occurs. The knee should be braked immediately and at the same time be elevated with ice and pressure according to the RICE principle, and if there is an open injury, it should be sterilized and aseptically bandaged immediately. Then immediately go to the hospital for examination. Meniscus tears are usually treated with arthroscopy or meniscus replacement surgery; fractures require surgery to open and reset the fracture and may require pinning or plate fixation; ligament tears or ruptures require ligament reconstruction surgery, and so on.

### **5. Preventive measures for knee injuries**

#### *5.1. Strengthening the protection of the knee joints*

For strengthening the protection of the knee joint is mainly divided into two aspects. The first is the reasonable use of protective gear in training, and the second is to strengthen the quality of knee training. Athletes can wear some protective gears for knee joints in training or competitions, for example, sports protective knee pads, leg straps, medical tape and so on. Protective gear can avoid athletes due to technical movement errors caused by knee injuries, for example, athletes in the game training because of action reasons and slipped and fell to the knee, not wearing protective gear is likely to cause moderate or serious injury, and wear protective gear can effectively reduce the fall on the knee caused by the injury. It can also provide support for the knee joint and relieve fatigue when the athlete is doing some high-intensity exercise. Athletes also need to strengthen some of the strength and flexibility training for the knee joint, to strengthen the knee joint ligaments, muscle groups, joint strength and flexibility, to avoid knee injuries due to the excessive strength of the primary muscle and insufficient antagonistic muscle strength. For example, straight arm kneeling single leg support, knee joint weight-bearing flexion and extension, lunge cross jump. These trainings can effectively strengthen the knee joint weight-bearing capacity and flexibility, which can not only improve the athletic ability but also provide protection for high-intensity training [9].

#### *5.2. Properly amount of load in training*

First, in the training process to maintain the principle of gradual and orderly increase in the exercise load until the limit load, in order to maximize the stimulation of the organism, so that it produces good adaptive changes, so that the physical and technical levels continue to improve to reach the optimal state. Secondly, when arranging the training load, pay attention to the relationship between load and recovery, because after bearing the training load there must be a certain amount of rest and recovery time to eliminate fatigue so as to produce fatigue-recovery-excessive recovery process. Otherwise, if the load is not recovered, the excessive accumulation of fatigue will cause knee injuries [10]. Lastly, the exercise load arrangement should be different for different training periods in table tennis training. For example, in the transition period, the main task is to recover and adjust, and at this stage, it is necessary to arrange small load training so that the athletes' physical strength can be recovered. In order to improve the technical level in the basic period, the load should be increased gradually and rhythmically. Pre-competition training needs to increase the load to the limit, but need to pay attention to the recovery and

adjustment, such as arranging outdoor activities to adjust the mood and physical strength, with the medical supervision to understand the changes in the physiological indicators of the athletes in a timely manner, to avoid excessive fatigue.

### 5.3. *Raising awareness of self-prevention*

Let athletes correctly realize the role of knee injury prevention, from the thought injury to improve self-prevention consciousness, is the premise of avoiding knee injury. First of all, athletes should understand the factors that cause knee injuries and learn the correct treatment methods after knee injuries, such as mastering the RICE treatment principle. Secondly, to carry out correct technical movement training, accurately grasp the movement essentials, so that the knee joint to reduce excessive bending, twisting, wear and tear and so on. There is also a need to strengthen the protection of the knee joint area, to avoid some unexpected situations that cause direct or indirect damage to the knee joint. In addition, the physical and functional conditions of athletes should be tested and personal medical files should be formed, so as to correctly find the causative factors and timely treatment after knee injuries occur. Finally, to improve the athletes' own attention, to judge whether the venue and equipment are reasonable, and to accurately prevent the knee injuries caused by the fall due to the slippery ground [11].

## 6. Conclusion

In summary, due to the knee joint in sports bearing a large amount of weight but also constantly twisting flexion and extension, so the probability of knee joint sports injury is relatively high, the main injury parts are meniscus, patella and collateral ligament. According to the different degree of injury can be divided into mild, moderate and severe injury. There are three main reasons for knee injuries: firstly, training reasons, training program and sports load arrangement is unreasonable, the part of the preparatory activities before training and relaxation after training is not in place. Secondly, psychological reasons, athletes have less understanding of sports injury cognition and are affected by psychological stress and sports injury. Finally, there are other reasons, the influence of the environment, field equipment is not standardized, clothing is unsuitable. Corresponding interventions are given for the degree and causes of knee injuries to strengthen athletes' self-prevention awareness, reduce the probability of knee injuries, and improve athletes' competitiveness. However, the correlation between knee injuries and geographical and weather factors is less analyzed, and the medical supervision system of athletes is not perfect. Therefore, the majority of sports workers should search for the causes of knee injuries in an all-round and multi-level way, put forward targeted preventive measures, and establish a perfect regular medical supervision, so as to provide basic protection for Chinese table tennis players and contribute to the development of China's sports industry.

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