

Achilles tendon injury repair and sports performance

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Abstract. Various Achilles tendon problems and injuries, ruptures in particular, are challenging and harmful to an athlete's general performance or to their game. The Achilles tendon is the strongest and thickest tendon in the human body; a strip of this connective tissue connecting the leg muscles to the heel is responsible for several essential functions involving running, jumping, or even standing. Considering the complexity and speed of the movement, athletes are more prone to occurrences of such damage, which usually has serious consequences, including the end of the career. The recovery methods after an Achilles tendon injury, either based on surgical or physical operations, are long and arduous but overall result in full recovery. Although surgical remedies provide a faster way to return to normal activity, they have some drawbacks, such as wound-healing issues. In contrast, the non-surgical methods, as less invasive, introduce a larger risk of re-rupture. After the injury, an athlete tends to reduce their performance. This manifests through a decrease in games played, efficiency, and return to performance for high dynamics sports, such as basketball or football. Meanwhile, for baseball, where the physical load on the Achilles tendon is different, such injuries do not affect as much the results. This fact reflects the importance of therapists to elaborate on methods of full functional return after surgery to bring the player back to identity.

Keywords: Achilles tendon, repair, sports performance.

1. Introduction

Nowadays, with more and more people participating in sports around the world, the damage of the Achilles tendon has become an inevitable problem. The data display that the injury rate of achilles tendon in developed countries is every 20,000 to 100,000 people per year. For athletes they are more easily to get injury of Achilles tendon and this will endanger the whole career. The most typical examples are Kobe, Liu Xiang and Bolt. The Achilles tendon is not only the most important part of the ankle, but also one of the most important parts of the whole body. It is the thickest and strongest tendon in the human body. The Achilles tendon is about 15cm long normally and is formed by the fusion of the tendons of the calf triceps in this process, the tendon fiber of the Achilles tendon has a 90° torsion. The main function of the Achilles tendon is to bend the calf and the ankle joint, which is the most important anatomical structure that the calf muscle strength is transmitted to the foot. People can stand upright, stand firmly, run and jump, and rely on it. So, if Achilles tendon get hurt the individual will lose the motor ability. Typically speaking, people think that Achilles tendon injury usually occurs in athletes, but actually Achilles tendon injury is more likely to occur in people who do not exercise all year round

or only exercise with low intensity. So, it's important to introduce that how to diagnose and treat that. Therefore, the aims of this paper are describing the injury of Achilles tendon, how to treat and the effect on sports performance.

Further understanding of the anatomy of the Achilles tendon, The Achilles tendon is the strongest tendon in the human body, it connects the gastrocnemius muscle at the back of the calf, the flounder muscle and the Achilles bone at the heel of the foot. It is located in the lower 1/3 of the calf and ends at the Achilles tuberosity, with the attachment point located subcutaneously and slightly upwardly lined by the posterior Achilles bursa and posterior Achilles tendon bursa. The Achilles tendon attaches to the back surface of the heel bone (the Achilles tuberosity), and this attachment point is capable of withstanding great forces from muscle contractions. The Achilles tendon has a special structure and function that can play a key role in sports, this structure allows the Achilles tendon to efficiently transmit the force of muscle contraction to the foot for plantar flexion.

The Achilles tendon receives blood from two major arterial sources: the tibial and peroneal arteries. The deep and superficial branches of the medial Achilles tendon artery, as well as the deep longitudinal branch, originate from the tibial artery. The Achilles tendon is nourished from the medial side and top to bottom by the former, while the latter is the main artery that runs the entire length of the tendon. The peroneal artery is divided into the superior and inferior external Achilles arteries, which supply the Achilles tendon from the lateral side.

The Achilles tendon is mainly composed of collagen fibers, several collagen fibers and vascular, lymphatic, and nerve fibers are then assembled into a single unit, which is wrapped by the bundle membrane to form the first fiber bundle; several first fiber bundles are then assembled into a single unit, which is wrapped by the bundling membrane to form the second fiber bundle; several second fiber bundles are then assembled into a single unit, which is wrapped by the bundling membrane to form the third fiber bundle; and finally several third fiber bundles are assembled into a single unit, which is surrounded by peritendinous tissue to form the Achilles tendon. Finally, a number of third fiber bundles are assembled into a single unit, which is surrounded by peritendinous tissue to form the Achilles tendon.

The two muscles most associated with the Achilles tendon are the gastrocnemius and flounder muscles. The gastrocnemius is a two-headed muscle, with the medial head originating from the medial femur and the lateral head from the lateral femur. The gastrocnemius muscle finally forms a muscle belly in the calf and changes into a tendon that joins the flounder muscle. Whereas the flounder muscle originates from the posterior side of the intersection of the head of the fibula and the tibia, it is a flat, wide muscle, and its tendon, opposite the gastrocnemius, merges with the tendon of the gastrocnemius in the lower part of the calf.

There are two general types of Achilles tendon injury the first one is Achilles tendinitis which is a degenerative lesion caused by strain caused by repeated severe stretching of the Achilles tendon. And the other one is Achilles tendon rupture. Which is one of the most serious injuries in the whole body. There are two types of Achilles tendon rupture, namely, Spontaneous rupture of Achilles tendon which is caused by Achilles tendon overburden during sports this is the most common one and the other type is Breakage caused by trauma which caused by Directly cut or hit the Achilles tendon to break it this is a really small part of this injury, so we will not talk about this one. In this article we will talk about how to treat them and diagnose that deeply. And also, achilles tendons plays a really important role in the body's motor system, which can Bend the ankle joint, bend the toes, maintain the standing posture, achieve movement, and realize jumping movement. So, we will also discuss how Achilles tendon do that and how can we strengthen and improve it to let it stronger

2. Treatment

Non-surgical or surgical treatment of acute Achilles tendon rupture has been debated. At the beginning of the 20th century, non-surgical treatment of acute Achilles tendon rupture was the mainstay of treatment, but the results were unsatisfactory. Starting in the 1920s, surgical treatment became the preferred treatment for acute Achilles tendon rupture, with the attendant complications. Starting in the mid-1980s, non-surgical treatment has gained increasing support [1].

2.1. Non-surgical treatment

Non-surgical methods are often considered for less active individuals or those with higher surgical risks. The primary approach involves immobilizing the foot in a cast, brace, or splint to allow the tendon to heal naturally [2].

The ankle is usually immobilized in a brace or cast, positioning the foot in a slightly flexed position to reduce tension on the Achilles tendon. This immobilization typically lasts for about 4 to 8 weeks to allow the tendon to heal.

Non-surgical treatment had the advantages of shorter morbidity and no hospital stay. While non-surgical treatment avoids surgical risks, there is a higher chance of re-rupture compared to surgical options.

2.2. Surgical treatment

Surgery is often recommended for younger, more active individuals or those who desire a quicker return to high-impact activities. There are several surgical techniques available:

2.2.1. Open Surgery. One benefit of the surgery is that it works and is good for athletes who need strong leg and foot muscles. However, because the Achilles tendon doesn't get enough blood, about 7.5% of patients have problems with their wounds not healing or healing slowly, getting infections, and other problems. In the worst cases, this can cause an infection and death of the Achilles tendon [1].

2.2.2. Percutaneous Surgery. The percutaneous approach to acute Achilles tendon rupture avoids the risks associated with incisional suturing and has the advantages of less injury, less postoperative scar tissue, shorter hospital stays, and lower cost.

2.2.3. Minimally Invasive Techniques. These are variations of the percutaneous approach, aiming to reduce the risk of complications like infection and scarring [3].

3. Rehabilitation and Recovery

Early light exercise after treatment can prevent joint stiffness and speed recovery. During early exercises, mild ankle movements such as toe extension and slight ankle flexion usually occur [5].

As recovery progresses, strength training is used to build strength in the calf and Achilles tendon muscles. This can be accomplished in the following ways. (Resistance Band Exercises: Use resistance bands to practice ankle flexion and extension. This helps to build the calf muscles.)

Heel raises: Heel raises on a flat surface or on steps can strengthen the calf and Achilles tendon.

As the Achilles tendon gradually regains flexibility and strength, functional training can be started. These exercises help the patient gradually return to a normal level of activity by simulating the movements of daily activities or specific sports. It may include [4,5].

Balance exercises: Practice ankle stability by standing on one foot.

Jumping exercises: Small jumping exercises with gradually increasing intensity can help to regain mobility.

Returning to daily activities and sports is the final stage of rehabilitation. This requires close supervision by a physician and physical therapist to ensure that the patient gradually increases activity levels without pain or discomfort.

Achilles tendon repair usually takes several months. The individual's age, activity level and treatment will determine the recovery schedule. The following is a generalized schedule [6].

4. Achilles Tendon injury related to sports performance

Achilles tendon is the biggest tendon in our body, which is we run, jump and walk depend on. The main function of Achilles tendon is conductive force. In this part we will mention that the difference between before and after injury.

First of all, we are going to show some data, which can display how much does Achilles tendon rupture affects the career of athletes?

Among the athletes who returned to the field, compared with the data before the injury, the number of appearances in the season decreased significantly at 1 and 2 years postoperatively, athletes played an average of 75.4%($P<.001$) and 81.9% ($P=.002$) But after the injury, the appearance rate dropped to 67.5% and 68.5%, respectively ($P<.001$) [7].

The data mentions that Achilles tendon rupture has a dramatic effect on athlete's career. It even may exterminate the motor ability of the athletes. But here is a question why there is a few impacts on MLB players, why most of them can back to the league again. In general, the incidence of Achilles tendon rupture in MLB has increased significantly since 1996. Rate of return to play in MLB after Achilles tendon rupture and repair is 62% for position players (non-pitchers) who suffer the injury. There was no association of injury with any player metric. It will still have a greater impact on non-pitcher players, such as outfielders [8], with Achilles tendon rupture. However, for the pitcher, if it is a power side injury, it will also have a greater impact. Therefore, the impact of Achilles tendon rupture on MLB players is still great, but the impact is not as great as that of basketball and football players.

Throwing the result, we can see that the most injury in MLB is power side and the main affect is on the speed of dash and jump. There are few impacts on pitchers. Therefore, we can see the Achilles tendon is mainly on the ability of run and jump. And why MLB player has a low impact when they recover from Achilles tendon injury.

Kobe Bryant is one of the greatest players in NBA history. Before the Achilles tendon rupture, he can average 27.3 points, 5.6 rebounds and 6.0 assists per game. However, the rupture of the Achilles tendon has a huge impact on Kobe. One year after the reimbursement of the season, Kobe only played six games, with an average of 13.8 points, 4.3 rebounds and 6.3 assists per game. From these data, we can clearly see that Achilles tendon rupture is a devastating blow to an athlete.

In the current survey, we have studied the athletes in the four major leagues in North America, and have determined the impact of Achilles tendon rupture on professional athletes. In general, 30.6% of athletes could not return to the field for two consecutive years after injury. In addition, the sports level was also significantly affected. And a large number of these injured athletes can no longer return to the previous competitive level after injury, but those who have returned to the previous level can usually recover after two years.

5. Conclusion

In this paper we mainly talk about the Achilles tendon injury, including the high-risk group, the planning structure of the Achilles tendon, treatment through surgery and non-surgical methods and the relationship between Achilles tendon rupture and sports performance. The aims of this paper are help to explain and introduce Achilles tendon injury. Make a general introduction to the Achilles tendon. Hope can help the people who are undergoing a Achilles tendon injury and know more about that. But in this paper we still can't find a better way to deal with the injury. Hope we can find the in the future.

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