

Examination, Diagnosis, and Treatment Techniques of Patellar Tendinitis

Zhaodong Bi^{1, †} Zeying Xie^{2, *, †}

¹ Rehabilitation Therapy, Shizhen College of Guizhou University of Traditional Chinese Medicine, Guiyang, China

² Rehabilitation Therapy, Tongji University, Shanghai, China

* Corresponding Author Email: 2050467@tongji.edu.cn

[†]These Authors contributed equally.

Abstract. Patellar tendinitis is one of the most common complications of patellar fracture in the adolescent population. This study specifically focuses on patellar fracture to introduce the causes and risks, examination, and treatment techniques of patellar tendinitis. Results show that the physical activity and overuse are the primary exopathic factors of patellar tendinitis, and tight thigh muscles, imbalanced muscles, overweight, patella alta, and the lower extremity skeletal alignment problems are the endopathic factors of patellar tendinitis. The examination includes both self-examination and medical examination. When the diagnosis is conducted, differentiating patellar tendinitis from other similar diseases is needed. The common treatments include conservative treatment and medical therapy. The conservative treatment is convenient and highly cost-effective, however, it usually needs a longer treatment period without significant effectiveness. Medical therapy is the last and most effective form of treatment, which includes wire loop fastening internal fixation, tension band fixation, Nickel-titanium patellar fixator, patellar plate fixation, partial patellar resection, and reconstruction of the patellar ligament. These five medical methods have their own characteristics. The wire loop fastening internal fixation is only used as a basis for joint fixation. The tension band fixation has a low rate of fixation failure while has a high loosening rate. Nickel-titanium patellar fixator can promote the early recovery of motor function. Patellar plate fixation is stable and reliable as well as has a low failure rate. Partial patellar resection and reconstruction of the patellar ligament can reduce knee degeneration, but it may result in postoperative knee pain and long-term traumatic patellar arthritis.

Keywords: Patellar tendinitis, Causes, Risks, Examination, Treatment Methods

1. Introduction

A patellar fracture is an orthopedic disease one of the more common types, also known as patellar ligamentaritis. The incidence has been rising in recent years that occur among adolescents the disease is mainly caused by fierce sudden violence and high-intensity sports such as playing basketball, volleyball, and running. It is often caused by long-term exercise and sudden intense activity. These situations cause acute/chronic inflammatory reaction of patellar ligament tendon injury, mainly manifested as knee joint pain, swelling, and limited joint movement.

The patellar tendon is the stop point of the tendon of the quadriceps in the patella. Patellar tendinitis refers to the inflammation of this part of the tendon. It is a common sports injury, and seriously affects the normal training and competition of athletes. Generally, conservative treatment is preferred to be used for the disease. As for the serious patellar tendinitis, surgical treatment is adopted, although the curative effect is still uncertain. For example, the recurrence rate of local closure is high, and repeated application could also cause tendon degeneration. In recent years, with the development of rehabilitation medicine, studies at home and abroad have reported the application of conservative treatment or surgical treatment, which has been gradually popularized in clinic.

This study focused on patellar tendinitis, described its causes and risks, examination, and detailed treatment methods.

2. Causes and risk factors

Patellar tendinitis is a common injury, which is caused by overuse, which mainly results from repeated stress on the patellar tendon. The strain might lead to tiny tears inside the tendon. When the tears in the tendon increase, they cause inflammation and the weakening of the tendon. When this tendon injury last for several days, it develops into tendinopathy. The power required for jumping, running, landing and else needs the patellar tendon to repetitively store and release energy. Energy stored and released from the tendons are important elements for some activities, which can reduce the energy cost of movements. Multiple factors can contribute to the development of patellar tendinitis, which can sum up into two categories including exopathic and endopathic factors.

2.1. Risk Factors

2.1.1. Exopathic Factors

The main exopathic factor is physical activity. Running and jumping are the major causes of patellar tendinitis. Athletes who do sports that involve running and jumping have higher risks to get this disease. For example, the incidence of patellar tendinitis in athletes who play volleyball and basketball, is at 45% and 32%. Thus this disease is also called “jumper’s knee”.

In addition, people doing flexion and extension repeatedly, which refers to overuse, is also the most reason that leads to the disease. Increasing the frequency and intensity may add stress to the tendon. For example, an amateur athlete who has been running for about 10 years got been suffered from patellar tendinitis several times, mainly because of repeated intense training schedules and overwhelming running kilometers. Besides, if people don’t have some stretching or relaxation after exercise, they may also have a higher risk of the disease. The abnormal length of thigh and calf muscles, tension relationships, and compliance can increase stress on the tendon and increase the risk of injury.

2.1.2. Endopathic Factors

There are two types of endopathic factors, the first one is related to the muscle and another is related to the bone.

Three main factors are related to muscle problems. The first one is the tight quadriceps and hamstrings, which will put more strain and stress on the patellar tendon. The flexibility will also decrease, thus leading to patellar tendinitis. Next one is imbalanced muscles. If some muscles in legs are not stronger enough, the weaker muscles may pull powerlessly on patellar tendon. This uneven strength could cause tendinitis. The last factor is overweight, which may put more stress on the tendon. Several studies show the relationship between overweight and patellar tendinitis. In the following study, there are 297 participants whose ages range from 50 to 79, with no experiences of pain or injury around the knee. Measured weight, body mass index (BMI), weight that reported by participants when they were 18–21 and their heaviest weight are all standard of obesity. The result is that the prevalence of MRI-defined patellar tendinitis was 28.3%. Present weight, BMI, the heaviest lifetime weight, and weight at age of 18–21 were all positively connected with the morbidity of patellar tendinitis. Thus, patellar tendinitis is associated with obesity [1].

Two factors associated with bone may result in patellar tendonitis. The first is patella alta, the symptom of which is that the patella is abnormally high in relation to the femur. It may weaken the relative fulcrum and increase the strength requirements for the quadriceps and this can easily lead to patellar tendonitis. The second one is the lower extremity skeletal alignment problems. For example, if the knee joint is not stable and always swings from side to side, then the tendon may get unnecessary stress.

2.2. Examination and Diagnosis

2.2.1. Self-Examination

Patients can check whether they get the patellar tendinitis by themselves. One test that reproduces the symptoms related to patellar tendinitis is the equal length load test, in which patients feel pain when they squat with one knee extended and another flexed, or have a deep squat (Figure 1). However, the pain relieves when squatting against the wall. This test produces a massive burden on the patellar tendon, leading to the attack of the pain in the region. It's also a way of treatment and prevention because squatting can activate the anterior thigh muscles (quadriceps femoris) and relieve the pressure on the patellar tendon [2].



Figure 1. The equal length load test [2]

Another one called the incline squat test is that if you feel pain when you squat but the pain relieves when you squat on a slope, then that might mean you have patellar tendinitis. Because compared with squatting on a flat, a slope can help reduce the pressure.

2.2.2. Medical Examination

As for clinical methods, the first step is to check whether patient's symptoms are caused by the problem of the tendon. Patellar tendonitis has specific and defining clinical signs. For example, pain are located at the inferior pole of the patella and when the need for the knee extensors grows, pain may also increase, especially in activities that require energy storage and release. During the exam, the doctor may apply pressure to the area around the knee to make sure where the injury is (Figure 2). The doctor may press under the patella and if the patient feel the pain right below the kneecap, then this means the patella tendon is injured. Around the injured tendon, there might have swelling and tenderness at the inferior border of the patella [3].



Figure 2. Sketch map of clinical method

Evaluating pain irritability is also an essential part of diagnosing patellar tendonitis and include determining the process of symptom worsening, and activities which need to store energy like training. The aggravation of symptoms can be shown as ache during loading activities. Pain standard can be estimated by an 11-point numeric rating scale, in which 0 means no pain and 10 is the worst, or numeric pain rating scale, where the level is judged by patients' facial expressions [3].

Besides stress testing by doctors, image detection is a more accurate way to test patellar tendonitis. Firstly, X-ray tests are mainly used to check whether the bones around the knee matter. However, it can only help to exclude other bone problems that can cause knee pain but not directly diagnose the patellar tendinitis.

The next one is the ultrasound. Ultrasound uses sound waves to make an image, revealing what happened in patellar tendon. Ultrasound can find intratendinous lesions that manifest lower echogenicity areas, mostly in the posterior area of patellar tendon. The injured side has a lower echo than the healthy side (Figure 3). The sensitivity of patellar tendinitis, which refers to the difficulty of diagnosing the disease, is 58%. The specificity of ultrasonography for patellar tendinitis, which is the accuracy of the diagnosis, is 94%. However, the disadvantages are that it rely on the operator and it has limited ability to eliminate the intra-articular disease with this modality.



Figure 3. Ultrasound image (the left one is the injured side and the right one is the healthy side)

The third way is magnetic resonance imaging, which is also called MRI. MRI apply a magnetic field and radio waves to take detailed images which can find minute changes in the body. Patellar tendinitis has a high signal on T2-weighted imaging, but has no signs of fiber breakage (Figure 4, Figure 5). The advantage of MRI over ultrasonography is that it can find intra-articular pathology, enabling a wide range of diseases to be contained in the differential diagnosis. The sensitivity and specificity of MRI for patellar tendinitis are 78% and 86% respectively. Compared with ultrasound, MRI has greater sensitivity, so MRI is initially chosen, although it has disadvantages of higher cost and a longer examination time [2].

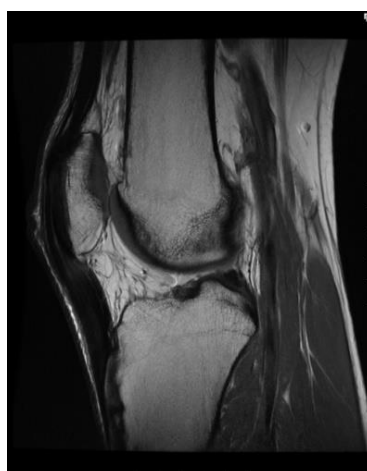


Figure 4. T1-weighted imaging of patellar tendinitis



Figure 5. T2-weighted imaging of patellar tendinitis

2.3. Differential Diagnosis of Patellar Tendinitis and Other Similar Diseases

Patellofemoral pain syndrome is most necessary to distinguish from patellar tendinitis. The patellofemoral joint pain syndrome is mainly caused by the synovial, and the position of the pain is not clear, which is usually located around the patella, compared with the patellar tendinitis. When it comes to the diagnosis of patellofemoral pain, it is often a diagnosis of exclusion, because there are no clear tests to diagnose this disease.

Another is the chondromalacia patellae. Its pain point is upper than the one of patellar tendonitis. This is mainly caused by the excessive wear of the patella but not the tendon, and the chondromalacia patellae can be distinguished by imaging examination.

The fat-pad injury of the knee is the third common differential diagnosis with patellar tendinitis. Patients with fat-pad injury of the knee feel painful when you extend your knee and squeeze the kneecap, or press both sides of the kneecap. The main difference between patellar tendinitis is the area of pain. Fat-pad pain is located the anterior inferior regio rather than the inferior pole, which is more dispersive. Rest and manipulation intervention can help relieve the pain. Fat-pad injury can be distinguished by X-rays, which have calcified shadows while the patellar tendinitis hasn't.

Patients' ages could also be taken into account in the differential diagnosis process. For example, patellofemoral pain syndrome is frequent in the elderly, while patellar tendinitis and fat-pad injury are common in adolescents [3]. It indicates that patellar tendinitis could be simply distinguished from patellofemoral pain syndrome based on age.

3. Treatment Techniques

3.1. Conservative Treatment

Conservative treatment is closely monitoring the progress of the disease and avoiding surgery and other treatments. As for the conservative treatment of patellar tendinitis, physical therapy and medical therapy are common measurements.

3.1.1. Physical Therapy

Physical therapy is the main body of rehabilitation treatment. And it functions through physical factors such as sound, light, cold, heat, electricity, and force (exercise and pressure). For local or systemic dysfunction or lesions, non-invasive and non-drug treatments are adopted to restore the original physiological function of the body. Physical therapy for patellar tendinitis includes cold therapy and shockwave therapy.

Cold therapy could alleviate reduce tissue damage by reducing blood flow and metabolic rate. It is found that electrical stimulation can promote collagen synthesis under laboratory conditions and is effective in the treatment of tendinopathy.

Shockwave therapy is a series of biological reactions inside and outside the cell regulated by mechanical pulse stamping strong waves conducted by physical mechanism and medium. The key therapeutic mechanism of the shockwave is the better healing response that is produced due to the inducing minimally invasive injury to the tissue invaded by articular fasciitis. The healing process causes angiogenesis and increases local nutrient supply, and promotes the repair of inflammatory synovium. By stimulating peripheral pain receptors including the free end and terminal nerve tip of the sensory nerve, the purpose of anti-inflammatory and analgesic is achieved. Therefore, it has a good effect on tendonitis or tendinopathy [4].

3.1.2. Therapeutic Massage

The main function of therapeutic massage is to reduce tendon load and pull muscles. Deep strumming is a special massage that originated in Finland and has been successfully used in patients with Achilles tendinopathy. It is thought to activate stem cells and promote tissue healing.

3.1.3. Advantages and Disadvantages

The advantages of conservative treatment are convenient and cost-effective, and its disadvantages are time-consuming and non-significant effective. Taking small splint fixation as an example, it needs to be fixed for a long time, leading to an adverse effect to promote the knee joint function recovery. Furthermore, its reduction and fixation effects are not obvious, especially for patients with the unstable joint. The fracture-dislocation and other problems may occur after reduction. For patients with patellar tendinitis, the problem of shortening of broken end and loss of height is easy to occurs in the process of external fixation with the small splint, resulting in late deformity, dysfunction, and unsatisfactory clinical treatment effect. In summary, conservative treatment is simple to operate and has little economic pressure. However, the treatment effect of external fixation is limited, and problems such as fracture-dislocation are easy to occur. It will limit the recovery of the patient's condition and even lead to a decline in the patient's quality of life [5].

3.2. Medical Therapy

If there is no progress after 6 to 9 months of conservative treatment, surgery may be considered as a last resort for tendinopathy.

3.2.1. Wire Loop Fastening Internal Fixation

Internal fixation with a wire ring is a common surgical method, that is, a wire ring is used to tie the lower part of the patella and wrap the whole patella. Research shows that the long-term effect of separate wrapping and fixation is not reliable, and it is easy to lose failing fixation. For comminuted lower pole fractures, the rotation, separation, and displacement of fracture blocks during knee flexion and extension cannot be limited. Moreover, when the internal fixation method is used alone, a longer postoperative cast is required. External fixation often leads to complications such as stiffness, adhesion, and limited function of the knee joint. At present, this method is only used as a basis for joint fixation.

3.2.2. Tension Band Fixation

Tension band technology can prevent the rotation instability of the fracture end through the tension band mode of cross surround. The tension band on the side of the fracture block is pulled, when the wire is bent to form tension and pressure; It puts pressure on the fracture through additional movement, dynamic rather than static, and considers that a little gap in the articular surface is necessary [6].

The method is analyzed from the perspective of biomechanics, the separation of fracture blocks during the knee joint movement trend is eliminated by changing the fixed tensile stress into compressive stress. The biomechanical effect of tension band wire fixation is found to be better than that of wire loop fastening.

3.2.3 Nickel-Titanium Patellar Fixator

Nickel-titanium patellar filler is designed according to the anatomy of patella biomechanics and the sliding trajectory of the patellofemoral joint. The Nickel-titanium shape memory alloy has many strengths such as the ability to multi-angle, centrality, and continuous aggregation, the internal fixator makes use of the memory of Nitinol alloy to press the bone end, making the fracture end of the patella can be closely attached and firmly fixed. This fixation method and surgical technique are simple to operate and can allow early functional exercise.

3.2.4 Patellar Plate Fixation

The commonly used patella plate is divided into upper and lower parts, and is mainly composed of two curved titanium plates and intermediate connectors. The shape and strength of the fixed fracture block can be pre-adjusted according to the specific conditions in the operation so that it is easier to stick to the surface of the patella, which is conducive to the recovery of the anatomical morphology of the articular surface. The fixation is stable and reliable, and the failure rate is low.

3.2.5. Partial Patellar Resection and Reconstruction of The Patellar Ligament

For the treatment of patellar comminuted fracture, partial inferior resection and patellar ligament reconstruction are controversial at present. Some scholars believe that, from the perspective of patella track and patella lower anatomical shape and biomechanics, the whole patella will shorten and move downward, the patella track and articular surface will change, and the interarticular pressure will increase even if the patellar ligament is firmly sutured and fixed with the retained patella body during patella lower pole resection, leading to postoperative knee t-pain and long-term traumatic patellar arthritis. In addition, sub-patellar or partial patellar resection should be performed with caution. Partial patellar resection is feasible when the lower pole of the patella is difficult to reduce or poorly reduced due to compressing fracture, because partial patellar resection can not only retain the role of the patella rod, avoid the reduction of patella extension force, but also ensure the smooth articular surface of the patellar bone and reduce knee degeneration [7].

4. Conclusion

This study discusses the causes and risks, examination, and treatment techniques of patellar tendinitis. The common causes and risks are physical activity, overuse, tight thigh muscles, imbalanced muscles, overweight, patella alta, and the lower extremity skeletal alignment problems. Examination and diagnosis comprise both self-examination and medical examination. The common treatments include conservative treatment and medical therapy. And the conservative treatment has the advantages of convenience and high-cost effectiveness, however, it also has some disadvantages, such as time waste and non-significant effectiveness. The medical therapy includes wire loop fastening internal fixation, tension band fixation, Nickel-titanium patellar fixator, patellar plate fixation, partial patellar resection, and reconstruction of the patellar ligament. The wire loop fastening internal fixation is a common surgical method but only is used as a basis for joint fixation. The tension band fixation has a low rate of fixation failure while has a high loosening rate. Nickel-titanium patellar fixator is a good method to promote the early recovery of motor function. Patellar plate fixation is stable and reliable, and the failure rate is low. Partial patellar resection and reconstruction of the patellar ligament can reduce knee degeneration, but it may result in postoperative knee t-pain and long-term traumatic patellar arthritis. The present study contributes to advancing the understanding of patellar tendinitis by providing insights into the causes and risks, examination, and treatment techniques. Thereby the clinician may offer the patient an appropriate diagnosis and treatment regimen.

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