

Current progress of rehabilitation studies for patellar tendinitis

Yucheng Ding

College of Physical Education, Taiyuan University of Technology, Taiyuan, 030002, China

dingyucheng5031@link.tyut.edu.cn

Abstract. Patellar tendonitis is a common exercise-related knee disease, which is a sterile inflammation that occurs on the ligament tendons of the patella, also known as patellar terminal disease, often due to long-term exercise or sudden strenuous activity caused by injury to the patellar ligament tendon to form an acute/chronic inflammatory response, mainly affecting athletes, runners and people who need frequent knee flexion. The occurrence of patellar tendinitis is closely related to damage, inflammation, and pain of the patellar tendon around the patella, mainly with knee pain, swelling, and limited joint mobility. Its clinical symptoms are knee pain, swelling, and movement disorders, which seriously affect the patient's daily life and motor performance. The rehabilitation treatment of patellar tendinitis mainly includes physical therapy, exercise, drug intervention and surgical treatment. These methods can be combined with each other and can achieve good rehabilitation results. However, the individualization of rehabilitation treatment is equally important and requires the joint efforts of medical staff and patients.

Keywords: Patellar Tendinitis, Sports Rehabilitation, Sports Injuries.

1. Introduction

Patellar Tendinitis (PT), also known as "jumping knee" or "runner's knee", is a common exercise-related knee disease, which is a sterile inflammation that occurs on the ligament tendons of the patella, also known as terminal patellar disease, often due to long-term exercise or sudden strenuous activity that causes injury of the patellar ligament tendon to form an acute/chronic inflammatory response, mainly affecting athletes, runners and people who need frequent knee flexion activities. The occurrence of PT is closely related to damage, inflammation, and pain of the patellar tendon around the patella, mainly with knee pain, swelling, and limited joint mobility. Its clinical symptoms are knee pain, swelling, and movement disorders, which seriously affect the patient's daily life and sports performance. Survey studies have shown that the prevalence of patellar tendinitis among high-level fencers in China is 38.5% of sports injuries [1]. The results of the analysis of magnetic resonance imaging (MRI) data of 60 knee joints of 34 Chinese women's volleyball team athletes showed that 41 (26 cases) of the 60 knee joints had patellar tendinitis, with a prevalence of 76.47% [2].

PT is widely recognized in the field of sports medicine, and the diagnosis of PT is mainly based on imaging, accompanied by clinical symptoms and past medical history. A variety of factors may contribute to the development of the disease, and the specific mechanism is not fully understood. At present, the commonly used treatment methods include local occlusion, non-steroidal anti-inflammatory

drugs, etc., but their efficacy is not good, and patients are prone to repeated attacks, how to seek better interventions, the effectiveness of their rehabilitation treatment and the best method is still a topic of great concern. In the past few decades, with the development of sports science and rehabilitation medicine, people have gradually studied the rehabilitation treatment of patellar tendinitis in order to provide patients with more scientific and personalized rehabilitation programs.

This study aims to systematically explore the rehabilitation treatment methods of patellar tendinitis, including physical therapy, exercise, drug intervention, surgical treatment, etc., and the application effects of these methods in clinical practice, explore its current status, problems and challenges, and propose possible solutions. Through the analysis of rehabilitation treatment methods, it is hoped that patients and clinicians can provide more accurate and scientific guidance to promote the rehabilitation process of patients with patellar tendinitis, reduce pain symptoms, improve quality of life and sports performance, in order to contribute to the rehabilitation treatment field of patellar tendinitis, provide patients with more effective and personalized rehabilitation programs, and promote the development of sports medicine and rehabilitation medicine.

2. Diagnosis

2.1. Clinical diagnosis

The prominent symptom of patellar tendinitis, in which pain and tenderness is located in the apex or patellar tendon rather than behind the patellar or on both sides of the tendon, is the main feature of the differential diagnosis of other knee disorders that are easily confused [3]. One study showed that the clinical symptoms of PT in badminton players were pain in half squatting, jumping, going up and down stairs, and severe pain when walking or standing still. Although the symptoms of mild people are not obvious, the symptoms are obvious in training, especially the pain is aggravated after training with a large amount of exercise, soft legs, and even the training plan cannot be completed. On examination, patellar apex and patellar tendon tenderness, thickening of the patellar tendon, and patellar apex elongation with patellar tendon pericarditis (apical patellar).

2.2. Imaging examination

Ultrasonography and MRI are used for imaging evaluation of patellar tendinitis, and "tendon thickening" is considered one of its characteristic manifestations. Studies have shown that the anteroposterior (AP) diameter of the proximal part of a normal tendon should not exceed 7 mm. In patellar tendonitis, tendons increase in T1-, T2-, and proton density-weighted images and proximal AP diameter [4]. A clinical study used ultrasonography and MRI to assess patellar tendon thickness in 65 elite college athletes. Studies of tendon thickness in relation to clinical patellar tendinitis, and calculation of cut-off values for tendon thickness, show that "patellar tendon thickening" is defined as more than 7 mm thick [5].

3. Etiology and injury mechanism of patellar tendinitis

3.1. Individual anatomical abnormalities

Anatomical abnormalities are abnormal changes or deformities in the structure of bones, muscles, ligaments, or other tissues near an individual's patellar tendon, causing the patellar tendon to be subjected to abnormal pressure or tension during movement. Some individuals may naturally live with abnormal structures in bone or soft tissues, such as patellar deformity and abnormal patellar tendon walking, which makes the patellar tendon vulnerable to injury. External factors or sports injuries may cause structural changes near the patellar tendon, such as patellar malacia and meniscal injuries.

3.2. Age and physiological state

With age, ligaments, tendons, and soft tissues may undergo degenerative changes, including a decrease in elasticity and strength, making them more vulnerable to injury. Tissue aging and joint wear and tear

leave the patellar tendon in a relatively fragile state, susceptible to additional stress or pull, increasing the risk of injury.

Excessive weight increases additional pressure on the patellar tendon and increases the risk of patellar tendon damage. Certain health problems such as metabolic diseases, joint diseases, etc. may affect the normal function of the patellar tendon. Overweight or obese puts more stress on the patellar tendon, increasing the risk of damage on it.

3.3. Excessive load and frequent use

Excessive loading can cause the patellar tendon to be subjected to constant pressure and stretching beyond its normal tolerance range, which may lead to micro-tears or an inflammatory response in the patellar tendon tissue, which can trigger the development of patellar tendonitis. Frequent use causes the patellar tendon to be subjected to constant pressure and friction, leaving it in a highly stressed state. This can cause fatigue and damage to the patellar tendon tissue, eventually triggering patellar tendonitis. Constant, high-intensity exercise or frequent flexion and extension of the knee can cause overload of the patellar tendon, which can trigger inflammation. This overload can be caused by continuous repetitive movements, sudden increases in exercise intensity or frequency, inappropriate training methods, etc. Some studies suggest that patellar tendonitis is caused by excessive overload on the patellar tendon insertion and attachment due to repeated rapid contraction and traction of the quadriceps muscles during frequent jumping, running, and kicking exercises [6].

3.4. Muscle imbalance and strength imbalance

Muscle imbalance and force imbalance may cause the patellar tendon to be subjected to uneven pressure and tension during movement, putting it under an additional burden, increasing the risk of patellar tendon damage. The quadriceps and hamstrings are key muscles for maintaining knee stability. If the quadriceps muscle is too tense, or the force imbalance between the quadriceps and hamstrings, it can lead to abnormal patellar position, increasing friction and pressure on the patellar tendon during movement.

3.5. Improper movement technique

Improper movement techniques are one of the important causes of patellar tendonitis, and may cause the patellar tendon to be subjected to additional stress and friction during movement. For example, jumping, squatting, running, etc., if not properly postured, increases the risk of patellar tendon damage.

3.6. Sports equipment and equipment problems

Unsuitable or damaged sports equipment may affect the stability and movement mode of the knee joint, resulting in uneven force during exercise, excessive pressure on muscles or ligaments in specific parts, and aging and worn or damaged training equipment may lose its original support performance, resulting in insufficient protection during exercise and increasing the risk of injury.

4. Rehabilitation of patellar tendonitis

Rehabilitation treatments for patellar tendonitis are constantly evolving, including physiotherapy, exercise, pharmacological intervention and surgical treatment. Physical therapy usually includes acupuncture, hot and cold compresses, physiotherapy, ultrasound, etc., which can effectively reduce inflammation and relieve pain. In addition, patients with patellar tendonitis often benefit from exercise, including exercises to strengthen the muscles around the patellar tendon and gradually increase the load on the knee joint. In terms of pharmacological interventions, NSAIDs are widely used to reduce pain and inflammation, but their long-term use requires careful consideration. Surgery is usually done to relieve knee pain by treating the damaged patellar tendon directly if conservative treatment fails to relieve symptoms or if the condition is severe.

4.1. Physical therapy

Physical therapy plays an important role in patellar tendinitis rehabilitation. Hot and cold compresses can relieve inflammation, promote blood circulation and reduce pain. Physical therapies such as physiotherapy, shock waves and ultrasound stimulate tissue repair and regeneration to help restore damaged patellar tendons. A randomized controlled study comparing the efficacy of ESWT (Swiss EMS extracorporeal shockwave therapy, model: Dolor Clast, study group) with nonsteroidal anti-inflammatory drugs (diclofenac enteric-coated tablets, control group) in the treatment of patellar tendinitis, the results showed that ESWT cure + improvement was 93.75% effective (RR), significantly higher than the control group 72.92% ($P < 0.05$), visual analogy score (VAS) score and joint function Baird-Jackson score study group were better than the control group ($P < 0.05$), further confirming that extracorporeal shock waves are safe and effective in the treatment of patellar tendinitis and are worthy of promotion [7]. Another study selected 32 cases of knee (25 males, 7 females, age 21~55 years old, disease course 1~15 months), through acupuncture to take acupoints, and any two acupuncture points, connected to the electroacupuncture to loosen the wave, to the degree of comfort, and then use ultrasound that can cause patients to feel slight pain subjectively, the intensity and dose of ultrasound, local treatment for 10min, the results showed that 65.6% of patients had no discomfort, no swelling and tenderness in their knees; 28.1% of patients had reduced knee pain and tenderness; 6.25% of patients had knee pain, Symptoms such as tenderness and activity limitation were not relieved, and the overall effective rate was 93.75%.

It can be seen that physical therapies such as acupuncture and ultrasound are effective in the treatment of patellar tendinitis [8]. The comprehensive application of these treatment methods can effectively reduce the discomfort of patients in the early rehabilitation stage and provide better conditions for subsequent exercise.

4.2. Exercise

Exercise plays an important role in the rehabilitation of patellar tendinitis. By gradually increasing the load, the strength of the muscles around the patellar tendon can be promoted and the tolerance of the patellar tendon can be improved. Studies have shown that centrifugal training can improve the Victori—an Institute of Spon Assessment (VISA) in patients with patellar tendon terminal disease, improve knee pain, and improve quadriceps muscle strength. Meta-analysis ($n=99$), with homogeneity between included studies ($I^2=0\%$, $P=0.63$), showed that eccentric training combined with other treatments such as strength training, physical factors, drugs and other treatments to improve pain often improved the VISA score of patients with patellar tendon disease alone ($SD=-4.84$, 95% CI: $-9.69\sim-0.01$). Centrifugal training is recommended for the clinical management of patellar tendinitis [9]. In another randomized controlled trial, 20 cases of peritendinitis of patellar tendon were randomly divided into experimental group ($n=10$) and control group ($n=10$), and the control group used conventional tuina and acupuncture therapy; On the basis of the control group, the experimental group added muscle strength exercises, range of motion exercises and functional training of the knee joints and the muscles around the knee joints in water. The results showed that aquatic exercise therapy improved the knee function score of patients (before treatment 63.14→after treatment 75.21) significantly better than that of the control group (62.52→71.14), and aquatic exercise therapy mainly exerted positive effects on muscle strength and joint mobility in addition to using the characteristics of water to relieve pain and swelling. The temperature of the water can stimulate the nerves, improve the stress ability of muscles, enhance muscle strength, relieve muscle spasms, reduce fatigue, and improve muscle working capacity. Water exercise can also enhance the myoelectric activity of the bone marrow muscles around the knee joint, coupled with the load on muscle activity, which can increase muscle protein synthesis and decrease degradation, thereby enhancing muscle strength, delaying muscle atrophy, and promoting functional recovery [10]. However, the process of exercise needs to be developed jointly by the patient and rehabilitation specialists to avoid overload leading to more serious injuries.

4.3. Pharmacological interventions

Pharmacological interventions have remarkable effect in relieving pain and inflammation. Nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and acetaminophen are widely used in the treatment of patellar tendinitis. However, the use of the drug should be done with caution, and long-term heavy use may cause adverse effects such as gastrointestinal problems. Therefore, rational drug use needs to be carried out under the guidance of a doctor.

4.4. Surgical treatment

Surgical treatment may have a positive impact on patellar tendinitis, especially when the conservative treatment does not relieve symptoms or the condition is severe, surgery can directly treat the damaged patellar tendon, reduce pain and inflammation, restore normal movement and function of the knee joint, and enable patients to better perform daily activities. Some surgical options, such as patellar tendon repair, can help relieve additional stress on the knee and reduce the risk of re-injury. In a clinical study using arthroscopic radiofrequency therapy for refractory patellar tendinopathy, radiofrequency therapy was shown to be effective in improving symptoms of anterior knee pain and greatly improving knee function [11]. However, it is worth noting that surgery also comes with certain risks and postoperative recovery period. Patients should communicate well with the care team about what to expect, risk, and the recovery process before and after surgery to make informed treatment decisions.

In summary, rehabilitation of patellar tendinitis should be individually designed on an individual basis. Different patients' conditions and physical conditions are different, so rehabilitation programs need to vary from person to person. Rehabilitation professionals should comprehensively consider the patient's age, gender, exercise habits and other factors, and develop a rehabilitation plan suitable for them to achieve the best treatment effect.

5. Evaluation and improvement of patellar tendinitis rehabilitation

The evaluation of the effect of rehabilitation treatment is also an important aspect of the study. Rehabilitation is usually evaluated by indicators such as pain level, functional recovery, and quality of life. Some studies have shown that a comprehensive rehabilitation regimen can significantly reduce pain, improve motor function, and increase quality of life in people with patellar tendinitis. At the same time, some studies have also found that the effectiveness of rehabilitation treatment may be affected by individual differences and need to be continuously adjusted and optimized based on patient feedback.

In order to further improve the effectiveness of rehabilitation treatment, it is necessary to continuously improve rehabilitation programs. Dryness classifies patellar tendinitis into five grades based on the degree of symptoms during training or activity, favoring pain self-testing in patients with patellar tendinitis [12]. In terms of physiotherapy, more innovative therapies, such as laser therapy, electrotherapy, etc., can be explored in order to improve the treatment effect. In terms of exercise, a more scientific and effective exercise plan should be designed according to the latest research results and clinical experience to ensure that patients can achieve the purpose of exercise and avoid the occurrence of injury. When it comes to surgical treatment, patients should communicate fully with the care team about the expected outcomes, risks, and recovery process before and after surgery to make informed treatment decisions. In terms of pharmacological interventions, new drugs or drug combinations can be studied to reduce pain and inflammation while reducing the occurrence of adverse effects.

6. Conclusion

In summary, the rehabilitation of patellar tendinitis is a complex and multifaceted process. The combination of physiotherapy, exercise, pharmacological intervention and surgical treatment can achieve good rehabilitation results. However, the individualization of rehabilitation treatment is equally important and requires the joint efforts of medical staff and patients. Future research should further explore innovative rehabilitation methods in order to provide better treatment options for patients with patellar tendinitis and help them recover as soon as possible and return to normal life and exercise.

References

- [1] Huang Li, Liu Haowei, Zhao Li, et al. Systematic evaluation and training of functional movement screening for patellar tendinitis in adolescent fencers: a case report [J]. Chinese Journal of Rehabilitation Medicine, 2022, 37(4): 537-539.
- [2] Wei Yongji, Jia Qianxin, Qu Hui, et al. MRI diagnosis of patellar tendinopathy in female volleyball players [J]. Chinese Medical Imaging Technology, 2011, 27(11): 2307-2310.
- [3] Mao Yusheng, Wang Yongli. Patellar tendon peritendinitis in badminton players [J]. Chinese Journal of Sports Medicine, 2000, 19(2): 217-218.
- [4] el-Khoury GY, Wira RL, Berbaum KS, Pope TL Jr, Monu JU. MR imaging of patellar tendinitis. Radiology. 1992 Sep;184(3):849-54.
- [5] Nishida Y, Nishino T, Tanaka K, Onishi S, Kanamori A, Yamazaki M. An Objective Measure of Patellar Tendon Thickness Based on Ultrasonography and MRI in University Athletes. J Clin Med. 2021 Sep 10;10(18): 4092.
- [6] Zhang Mingyao, Su Shuijun. Characteristics and protective methods of sports injuries among college football students [J]. Sports and Sports Products and Technology, 2021(22):105-107.
- [7] Yan Hongmei, Meng Qisheng. Observation on the efficacy of extracorporeal shock wave in the treatment of patellar tendonitis in 48 cases [J]. Zhejiang Trauma Surgery, 2019, 24(4): 730-732.
- [8] Lin Songqing. Acupuncture plus ultrasound in the treatment of patellar tendonitis [J]. Xinjiang Traditional Chinese Medicine, 2021, 39(2):39-40.
- [9] Wang Lu, Yu Ge, Ruan Bin, et al. Meta-analysis of the therapeutic effect of eccentric training on patellar tendon disease [J]. Chinese Journal of Rehabilitation Medicine, 2021, 36(6): 719-723.
- [10] Sun Peng. Research on the rehabilitation effect of aquatic exercise therapy on patients with patellar tendinitis [J]. Fujian Sports Science and Technology, 2016, 35(5):37-39.
- [11] Wu Yang, Chen Shiyi, Dong Yu. Retrospective study of arthroscopic radiofrequency treatment of refractory patellar tendinopathy [J]. Chinese Journal of Sports Medicine, 2017, 36(3): 248-250.
- [12] Gan Chang. Research progress on sports rehabilitation for patellar tendonitis [J]. Boxing and Fighting, 2021(14):125.