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A Review of the Literature on Patellar Tendinopathy: Current State of Knowledge

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ABSTRACT

Introduction:

Patellar tendinopathy, commonly referred to as jumper's knee, presents as pain and dysfunction in the patellar tendon, predominantly affecting athletes engaged in jumping sports. The symptoms of patellar tendinopathy not only impact sports involvement but also interfere with activities of daily living, such as climbing stairs and sitting for extended periods, which in turn affects overall well-being. A variety of treatment options are available, encompassing both conservative approaches, such as modifying activity levels and undergoing physical therapy, and surgical methods.

Aim of the study:

The objective of this study is to review the current literature regarding the incidence, risk factors and currently available treatment methods for patellar tendinopathy. In addition, the aim is to present a summary of the knowledge and information collected so far in this area in a concise and accessible format.

State of knowledge:

The epidemiology and mechanisms of patellar tendinopathy are already well documented and described. The statistics regarding the incidence of patellar tendinopathy among athletes in the given fields are sufficiently consistent with each other. The existing literature provides insights into the efficacy of various therapeutic approaches for patellar tendinopathy, yet it is limited in scope.

Conclusion:

This review acknowledges that recent advancements in research have led to a fuller understanding of epidemiology and improvement of treatment methods for patellar tendinopathy. Despite this, a single therapy is not sufficient for optimal outcomes. Therefore, it is recommended that a comprehensive approach to conservative treatment be adopted. Further research and clinical trials are essential for the generation of reliable conclusions.

Key words: patellar tendinopathy, jumper's knee, knee pain

Introduction

Patellar tendinopathy (PT), commonly referred to as jumper's knee, is identified clinically by experiencing pain and impairment in the patellar tendon. It predominantly affects athletes engaged in jumping activities, typically from their teenage years up to their forties. This ailment imposes restrictions on both recreational and professional athletes, hindering their sports involvement and potentially terminating careers. The exacerbation of symptoms not only impedes participation in sporting activities but also disrupts everyday activities such as stair climbing, squatting, transitioning from a standing to a seated position, and prolonged periods of sitting, thereby affecting overall health and well-being [1,2].

The treatment of patellar tendinopathy involves the use of a range of approaches, including rest, modifications to activities, taping, eccentric exercises, anti-inflammatory drugs, shock-wave therapy, electrolysis and surgery. Despite this array of treatment options, there is no single approach that has proven consistently successful in achieving complete recovery. Initially, a focus is placed on the implementation of conservative approaches, such as medical and physical therapies, with the objective of modifying activities in order to reduce stress on the tendon. It is of paramount importance to address any strength imbalances that may exist in the hamstring and quadriceps muscles, as well as to improve flexibility, in order to maintain proper biomechanics during everyday movements and sports-related activities such as walking, running, and jumping [3,4].

Prevalence and risk factors

Since the turn of the 21st century, there has been a global increase in the prevalence of tendinopathy, resulting in long-lasting or permanent functional limitations for individuals, regardless of their involvement in sports, and across all age demographics. Data derived from both the general population and patients seen in primary care settings indicate that approximately 1-2% of adults aged 18-65 will develop lower limb tendinopathy during their lifetime. Although tendinopathy can manifest at any age, it is most commonly diagnosed between the ages of 18 and 65, accounting for over two-thirds of cases across all age groups. The frequency of tendinopathy increases with age, with females exhibiting a greater susceptibility compared to males. Among children and adolescents under the age of 18, the prevalence of tendinopathy ranges from 8% to 33%, with boys exhibiting higher rates [5,6].

Most tendinopathies in the lower limbs involve the Achilles tendons or patellar tendons. The incidence of PT in the general population is about 1,6% [5]. The prevalence of patellar tendinopathy is estimated to be as high as 14% among athletes. However, among athletes engaging in high-impact sports such as basketball or volleyball, the rates escalate even to 30% or 40%, making it the one of the most prevalent orthopaedic condition in these disciplines [7, 8, 9]. Zwerver et al. conducted research on 891 non-elite athletes, comprising both male and female participants, who were engaged in seven commonly played sports. The findings revealed that the general occurrence of patellar tendinopathy was 8.5%. Among the sports examined, volleyball athletes exhibited the highest prevalence (14.4%), followed by handball (13.3%) and basketball (11.8%). The prevalence of patellar tendinopathy among track and field athletes was 6.9%, followed by field hockey at 5.1%, korfball at 4.8%, and soccer players at 2.5% [10].

The most commonly cited risk factors for patellar tendon injury among athletes in various sports are male gender, high body weight, high height, hard playing surface and repeated elements of jumping during training that place additional stress on the patellar tendon [8,11].

A number of factors, both modifiable and non-modifiable, contribute to the development of tendinopathy. These encompass intrinsic and extrinsic risk factors, in addition to hormonal and metabolic conditions, which have been observed to influence both the occurrence and severity of injury, as well as the efficacy of rehabilitation efforts in specific patient populations. It is notable that tendinopathy appears to be more prevalent among individuals with conditions such as diabetes mellitus, hypercholesterolemia, rheumatic diseases, and renal diseases [12].

Furthermore, the utilisation of antibiotics has been linked to an elevated risk of tendinopathy and tendon rupture, with an incidence ranging from 2% to 15% in comparison to control groups. Specific occupational environments characterised by strenuous activities, particularly those involving forceful exertion or repetitive motions, also increase the risk of developing tendinopathy. Such occupations include those in the food industry, magazine workers, and construction work. Furthermore, genetic factors play a significant role in maintaining tendon health and influencing the balance between repair and degeneration following injury [5].

Pathophysiology and patomechanisms

The pathogenesis of tendinopathy is a complex phenomenon involving numerous factors and theories aimed at elucidating its underlying pathophysiology. In the case of patellar tendinopathy, several hypotheses have been postulated, including those pertaining to vascular, mechanical, impingement-related, and nervous system factors. Among these, chronic repetitive tendon overload is widely accepted as the primary causative factor. The prevailing view is that such overload leads to structural damage in the microscopic collagen fibrils within the tendon, resulting in matrix deterioration. Although early tendon injuries typically elicit a healing response, if intrinsic healing abilities are inadequate or recovery is inadequate, matrix damage can accumulate over time. This microscopic damage, induced by heavy loads, results in cellular-level changes that compromise the tendon's mechanical integrity. These initial structural changes often remain asymptomatic and unnoticed. However, over time, the gradual buildup of matrix damage, along with the release of various inflammatory mediators, eventually leads to the manifestation of symptoms. Our current understanding of tendinopathy's development has significantly evolved in recent years, thanks to research using animal models and patient tissue studies. These studies have provided valuable insights into the early cellular and molecular alterations that drive its progression [5,13,14,15].

Symptomatology

Patellar tendinopathy is a condition characterized by anterior knee pain that is linked to activity. The pain typically emerges in the lower pole of the patella and the upper part of the patellar

tendon. The pain develops gradually and can be triggered by increased sports activity. Initially, the pain emerges post-activity, however it may progress to become constant or continuous and persist even at rest [14]. The symptoms associated with patellar tendinopathy have both short- and long-term effects, with an average duration of 19 months and potentially exceeding 32 months in professional athletes [16]. During a physical examination, tenderness is typically felt at the upper portion of the patellar tendon upon palpation and at the lower pole of the patella when the leg is fully extended, with pain decreasing with knee flexion [14]. A significant diagnostic test is the single-leg decline squat, whereby the patient performs a squat on the affected leg on a 25-degree decline board, recording the maximum knee flexion angle achieved and pain levels on a visual scale. It is important that the pain remains localised to the tendon/bone junction during this test. This examination is useful for self-assessment and monitoring of the tendon's response to load. Furthermore, a reduction in quadriceps strength and an increase in the tension of both the quadriceps and hamstring muscles may be observed during the physical examination [1,14].

The principal condition to be taken into account when making a diagnosis of patellar tendinopathy is patellofemoral pain syndrome. This syndrome is characterised by a non-specific discomfort in the knee, typically occurring around or behind the patella. This syndrome is often accompanied by crepitus, which may be described as a grinding or rubbing sensation, beneath the patella during knee flexion, and tenderness along the patellar facets. Distinguishing patellar tendinopathy from patellar tendon pain involves an assessment of the patient's responses, including tenderness and tissue response, during resisted knee extension and functional tasks. Nevertheless, it is crucial to acknowledge that patellar tendinopathy and patellofemoral pain may manifest concurrently. Other potential diagnoses include cartilage degeneration, meniscal injury, fat-pad impingement syndrome, and bony abnormalities such as Osgood-Schlatter syndrome [6,16].

Diagnosis

The diagnosis of PT is frequently made on the basis of the patient's detailed description of the location and nature of the pain, as this enables the most effective utilisation of additional diagnostic resources and the confirmation of the diagnosis by imaging studies.

Imaging methods such as ultrasonography (US), Doppler ultrasonography, magnetic resonance imaging (MRI), and X-rays are commonly employed by physicians to diagnose patellar tendinopathy. While X-rays provide an initial view of the joint and identify bone issues, MRI and US offer more detailed images of the tendon. US can detect a hypoechogenic area associated with tendon thickening in PT patients, which is usually found in the posterior part of the patellar tendon near the inferior pole of the patella. Doppler ultrasonography can identify neovascularisation and increased blood flow. It can also detect increased extracellular fluid and collagen fibre breakdown in partial tears, which may be linked to pain. Magnetic resonance imaging can reveal patellar tendinopathy as a thickened tendon with areas of heightened signal intensity, particularly showing partial tears on T2-weighted images with high signal intensity. Both ultrasound and magnetic resonance imaging have advantages and disadvantages. US may fail to detect intra-articular issues and depends on operator skill. Conversely, MRI can detect intra-articular problems but may not always be accessible, and is more expensive and time-consuming. The sensitivity and specificity rates for US in diagnosing PT are 58% and 94%, respectively, compared to 78% and 86% for MRI [7,8,17].

Treatment

The rehabilitation of patellar tendinopathy represents a prolonged and demanding journey for both patients and healthcare providers. Despite the multitude of treatment approaches that have been explored for PT, a definitive consensus on the most effective strategy remains elusive. In general, conservative treatments are the preferred approach, with surgical options reserved for individuals with advanced symptoms and reduced functionality, particularly following unsuccessful conservative attempts. The rehabilitation process for patellar tendinopathy typically encompasses the management of symptoms, reduction of load, recovery, rebuilding of strength, and eventual return to unrestricted sports activities. Treatment progression is individually determined, considering factors such as the condition's severity, patient compliance, pain levels, and symptom duration. A range of conservative management strategies may be employed, including the modification of activities, the engagement in exercise rehabilitation and the application of therapeutic methods [16,18].

Physical therapy, with a focus on eccentric quadriceps exercises, is a common treatment approach in the management of this condition. Other non-surgical interventions include

injections with sclerosing agents, low-intensity pulsed ultrasound, shockwave therapy, platelet-rich plasma injections, and corticosteroids. In instances where conservative treatment has been unsuccessful, open or arthroscopic debridement of areas exhibiting chronic inflammation and tendon degeneration may be employed to stimulate a healing response [19].

Non-operative methods

Isometric and isotonic exercise

A review of the available studies indicates that isometric exercise resulted in a notable and enduring decrease in tendon pain, while isotonic exercise did not achieve the same level of pain reduction or sustain it. In one study, participants in the isometric group performed five 45-second isometric holds at 70% of their one repetition maximum (RM), whereas those in the isotonic group completed four sets of eight repetitions with a 4-second eccentric phase and 3-second concentric phase at 100% of their eight RM. In a further study employing a comparable protocol, the isometric group executed five 45-second holds at 60 degrees of knee flexion at 80% maximal voluntary isometric contraction, while the isotonic group performed four sets of eight repetitions at 80% of their eight RM with the same eccentric and concentric phases. Both types of exercise yielded a clinically significant reduction in pain and improvement in function during a four-week trial with athletes in-season training. However, in a study that employed the same isometric protocol but with a 4-second eccentric and 3-second concentric phase for the isotonic protocol, it was found that isometric contractions provided significantly greater immediate pain relief compared to isotonic contractions throughout a 4-week in-season trial. Isometric exercise consistently led to an immediate reduction in knee pain, which was sustained for a brief period afterwards in all three studies. In contrast, isotonic exercise proved effective in only one of them [20,21,22].

Platelet-rich plasma (PRP) injections

Platelet-rich plasma therapy involves the injection of platelets and cytokines into degenerative tissue with the objective of accelerating healing and reducing recovery time. PRP is derived from a patient's own blood through centrifugation, whereby the platelets and growth factors are concentrated to enhance tissue repair. Given that patellar tendinopathy is associated with tendon

repair issues, PRP shows promise in addressing this condition. While PRP injections have been employed in a variety of medical settings for several years, their application in sports medicine has been relatively recent, due to the lack of conclusive evidence supporting their effectiveness. Although initial results are promising, further high-quality randomised studies are required to establish PRP as the gold standard treatment for PT. While PRP may be considered a second-line option for tendinopathies unresponsive to conservative treatments, numerous questions remain unanswered regarding its biological mechanisms, optimal application methods, and comparative advantages and disadvantages. Further research is required in order to provide clearer guidelines on the usage of PRP in the treatment of PT [23,24,25].

Hyaluronic acid (HA)

Hyaluronic acid is a glycosaminoglycan composed of glucuronic acid and N-acetyl glucosamine units. It is widely distributed in both vertebrate and invertebrate extracellular matrices, where it provides mechanical support, viscoelasticity, hygroscopic properties, and anti-inflammatory effects to tissues. HA is a crucial component of cartilage and tendon tissue, contributing to their viscoelastic nature. Although it enhances fibroblast activity, including adhesion, extracellular matrix synthesis, and proliferation, the precise role of hyaluronic acid in tendon biomechanics remains unclear. Furthermore, HA displays anti-inflammatory, wound healing, antiangiogenic, and immunosuppressive effects, rendering it a potential therapeutic agent for patellar tendinopathy. Clinical studies have demonstrated the efficacy of HA in the treatment of athletes with PT, with pain reduction and improved performance observed in the long term. Nevertheless, there remain unresolved questions regarding the metabolism of hyaluronic acid, its interactions with receptors, and its actions in inflammation, particularly in relation to its molecular weight. A more comprehensive understanding of these mechanisms could facilitate the development of more efficacious pharmaceutical, biomedical, cosmetic, and food supplement applications, with greater specificity in their effects [26,27].

Extracorporeal shockwave therapy (ESWT)

Extracorporeal shockwave therapy is a procedure that involves the use of a pneumatic generator to generate focused high-energy shock waves, which are directed from the skin's surface to the affected area. This therapy is becoming increasingly popular for the treatment of musculoskeletal conditions, particularly tendinopathies. The precise mechanisms underlying

the reduction of pain and improvement in function following ESWT remain unclear. Potential explanations include hyperstimulation analgesia, whereby excessive stimulation suppresses pain receptors. Furthermore, the mechanical load applied by ESWT has been shown to promote neovascularisation at the bone-tendon junction and increase growth factors, which in turn facilitate tendon regeneration [28].

Despite its widespread use, there is a paucity of clear clinical guidelines for the treatment of patellar tendinopathy with shockwave therapy, which has led to uncertainty among clinicians. The clinical guidelines for the treatment of Achilles tendinopathy vary considerably. One guideline does not recommend shockwave therapy, whereas another suggests it as an adjunctive modality. This discrepancy could potentially lead to confusion among clinicians regarding the appropriate use of shockwave therapy in clinical practice. Moreover, recent reviews of the effectiveness of shockwave therapy for Achilles tendinopathy have been criticised for not taking into account variations in the characteristics of study participants and the protocols used in the treatment. Similar issues also exist in clinical guidelines for physiotherapy, with one recommending shockwave therapy as a secondary approach and the other not [29].

Surgery

It is evident that non-invasive therapies are efficacious in the majority of cases of patellar tendinopathy. Nevertheless, approximately 10% of patients do not respond to such treatments and eventually necessitate surgical intervention. A variety of surgical approaches exist, including open and arthroscopic surgery, which aim to perform tenotomy of the patellar tendon, remove abnormal tissue, and stimulate repair by drilling and marginal resection at the inferior pole of the patella [14].

Open surgery involves making a longitudinal incision from the inferior pole of the patella to the tibial tubercle, exposing and opening the paratenon, accessing the posterior degenerative tissue through a longitudinal incision in the tendon, and resecting the distal 5 mm of the patella before perforating the inferior pole with a drill. The initial step in arthroscopic surgery is diagnostic arthroscopy, which is employed to rule out intra-articular pathology. This is followed by the identification and resection of the inferior pole of the patella's adjacent synovial tissue, as well as the removal of degenerative tissue in the posterior zone of the proximal patellar

tendon until normal tendon fibres are visible. Subsequently, haemostasis and articular lavage are performed [14,30].

The efficacy of surgical intervention in comparison to other treatment modalities, such as eccentric exercises or injections, remains uncertain. The evidence available indicates that surgery may not offer significant benefits over eccentric exercises in terms of pain, function, or treatment success. However, it may provide meaningful pain reduction and treatment success compared to sclerosing injections. Nevertheless, further research is required to substantiate these findings, given the limited sample sizes and potential for bias. Surgery is frequently employed in the treatment of late-stage patellar tendinopathy when other treatments have been unsuccessful. However, the benefits of surgery in this context remain unproven [31].

There is compelling evidence supporting surgical intervention for recalcitrant cases of patellar tendinopathy, particularly in patients presenting with severe symptoms who have not responded to non-surgical management. It is possible that differences in surgical techniques may contribute to variations in outcomes between arthroscopic and open surgery. Some studies have reported lower improvement rates among patients undergoing arthroscopic surgery compared to those undergoing open surgery [19].

Conclusions

The information presented in this review broadly encompasses the field of patellar tendinopathy. However, due to limitations in the available data, full coverage of the topic is not possible. This is particularly evident in the context of the actual effectiveness of certain therapies. Nevertheless, it is evident that no singular therapeutic approach is sufficient to achieve optimal outcomes. A comprehensive approach, employing a range of techniques in conservative treatment, is the only method that can provide long-lasting and satisfactory results. Moreover, the results of numerous studies diverge significantly, particularly with regard to conservative treatment. Nevertheless, the presented review of the existing literature may prove to be of significant benefit to clinicians dealing with this disease. It is evident that further research and clinical trials are necessary to substantiate the reliability of the conclusions drawn.

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