The Role of Physiotherapy in Managing Patellar Tendinopathy: A Comprehensive Review

Alhussain Ibrahim Ahmed Moafa (1), Abutaira Moyed Nasser Jaffari (2), Abdu Hasan Hamdi (3), Ibrahim Abubakr Alshamrani (4), Khalid Mohammed Alharbi (5), Moawiah Issam Alhomsi (6), Qassim Jebril Qirti (7), Ibrahim Hussain Abdu Buayti (8), Abdullah Qied Fallaj Almotairi (9), Abdullah Omar A Alshehri (10), Wiam Mohammed Ahmed Suhaqi (11), Abdualaziz Abdallah Mohsen Sahli (12), Taibah Abubaker Salem Bajafer (13), Ahmed Ali Mohammed Kaabi (14), Nasser Mohammed Alanazi (15).

1. Physiotherapy, Damad General Hospital, Ministry of Health, Kingdom of Saudi Arabia. Aimoafa@moh.gov.sa
2. Physiotherapist, Ministry of Health Branch in Jazan, Ministry of Health, Kingdom of Saudi Arabia. ajaffary@moh.gov.sa
3. Physiotheapy, Hospital Abu Arish General, Ministry of Health, Kingdom of Saudi Arabia. ahhamdi@moh.gov.sa
4. Occupational Therapy, Eradah Complex and Mental Health in Riyadh, Ministry of Health, Kingdom of Saudi Arabia. h.me.1@hotmail.com
5. Occupational Therapist, Eradah Hospital and Mental HealthAl-Kharj. Ministry of Health, Kingdom of Saudi Arabia. ghaidani.90@gmail.com
6. Occupational Therapist, Erada Hospital and Mental Health in Al-Kharj, Ministry of Health, Kingdom of Saudi Arabia. moawya12@gmail.com
7. Physiotherapy Technician, Prince Mohammed Bin Nasser Hospital, Ministry of Health, Kingdom of Saudi Arabia. Qqirati@Moh.Gov.Sa
8. Specialist physiotherapy, General Sabia Hospital, Ministry of Health, Kingdom of Saudi Arabia. heema555@hotmail.com
9. Physiotherapy Technician, Ramah General Hospital, Ministry of health, Kingdom of Saudi Arabia. abdallhvib11@gmail.com
10. Health Assistant-Emergency Medical Services, Therapy and Rehabilitation, Ministry of Health, Kingdom of Saudi Arabia. aboalshehri@moh.gov.sa
11. Physiotherapist, Prince Mohammed bin Nasser Hospital, Ministry of Health, Kingdom of Saudi Arabia. Physiotherapy@outlook.sa
12. Physiotherapy, General Sabia Hospital, Ministry of Health, Kingdom of Saudi Arabia.
13. Physiotherapist, Prince Mohammed bin Nasser Hospital, Ministry of Health, Kingdom of Saudi Arabia. Pt.taibah@gmail.com
14. Physiotherapy Technicia, Prince Mohammed Bin Nasser Hospital, Ministry of Health, Kingdom of Saudi Arabia. AAKAABI@MOH.GOV.SA
15. Physical therapy technician, Ministry of Health, Kingdom of Saudi Arabia.

Abstract

Patellar tendinopathy, commonly known as jumper's knee, is a prevalent overuse injury affecting athletes engaged in jumping sports. It is characterized by pain and dysfunction in the patellar tendon, significantly impacting quality of life and athletic performance. Diagnosis is based on clinical assessment and imaging, with a notable disconnect between imaging findings and pain. Management involves a comprehensive approach, including load management, progressive resistive exercises, and addressing kinetic chain deficits. Eccentric training, heavy slow resistance exercises, and functional strengthening have demonstrated effectiveness in reducing symptoms and improving function. Passive interventions, such as manual therapy and bracing, may complement active rehabilitation but lack robust evidence. Extracorporeal shockwave therapy, corticosteroid injections, and platelet-rich plasma injections have shown mixed results and require further

research. Surgical options may be considered in severe cases. Educating athletes on the rehabilitation process and empowering them to monitor symptoms is crucial for successful outcomes. Factors affecting prognosis include pain severity, dysfunction, rehabilitation quality, and individual athletic demands. Central sensitization and upregulation of the central nervous system may play a role in pain mechanisms, warranting additional investigation. A comprehensive, individualized approach integrating load management, progressive strengthening, and athlete education is essential for optimal recovery and return to sports in athletes with patellar tendinopathy.
Keywords: Physiotherapy, Patellar Tendinopathy, jumper's knee

Introduction

Patellar tendinopathy, commonly referred to as jumper's knee, is characterized by pain and dysfunction in the patellar tendon. It primarily affects athletes engaged in jumping activities, typically from adolescence to the fourth decade of life. This condition significantly impacts health and quality of life by restricting sports and physical activities for recreational athletes, and it can be career-ending for professionals. When symptoms worsen, even daily activities such as ascending or descending stairs, squatting, transitioning from standing to sitting, and prolonged sitting may be impaired.

Clinically, patellar tendinopathy presents as localized pain at the proximal attachment of the tendon to the bone during high-load activities, such as jumping or rapid directional changes. Tendon pain at the superior attachment of the patella (quadriceps tendinopathy) or at the tibial attachment occurs less frequently, but the diagnosis and treatment approaches are comparable to jumper's knee. Diagnosis is often based on clinical assessment alongside imaging, such as ultrasound or magnetic resonance imaging, typically to exclude differential diagnoses like patellofemoral pain. Imaging may reveal structural abnormalities in the tendon that indicate pathology; however, a notable disconnect exists between imaging findings and pain. It is common for individuals with pain-free functionality to exhibit tendon abnormalities on imaging(Cook et al., 2018). For clarity, this discussion uses the term "tendinopathy" to describe painful tendons and "tendon pathology" to refer to abnormal imaging or histopathology findings without reference to pain.

Management of patellar tendinopathy often involves lengthy rehabilitation and may not always yield successful outcomes. Challenges in treatment stem from a limited understanding of the condition's etiology, insufficient knowledge of risk factors, and a scarcity of effective, time-efficient interventions. Many therapeutic protocols are extrapolated from research on other tendinopathies and applied to the patellar tendon, but the structural and clinical differences between tendons may undermine the validity of such approaches. This review explores the prevalence, associated and risk factors, diagnostic methods, and evidence-based treatment strategies for patellar tendinopathy, supplemented by expert opinion where evidence is lacking.

Prevalence

Patellar tendinopathy is an overuse injury that typically develops gradually. Athletes with mild to moderate symptoms often continue to train and compete, making it difficult to accurately determine prevalence through time-loss injury records. Overuse injuries are often underreported in models that define injuries solely based on missed competition or training, as these models primarily capture acute injuries and severe overuse injuries(Clarsen et al., 2013).

Research focusing specifically on the prevalence of patellar tendinopathy highlights variations depending on the sport. Studies show that volleyball players have the highest prevalence among recreational athletes (14.4%), while soccer players have the lowest (2.5%). The prevalence is significantly higher among elite athletes. Imaging studies on asymptomatic elite athletes report tendon pathology in 22% of cases, with male athletes exhibiting double the prevalence of female athletes. Among the investigated sports—basketball, netball, cricket, and Australian football—basketball players had the highest prevalence of tendon pathology (36%)(Cook et al., 2010). Furthermore, patellar tendinopathy is not limited to adults; young basketball players show a prevalence of 7%, while 26% exhibit tendon pathology on imaging despite being asymptomatic.[4]

Patellar tendon rupture, in contrast, is rare. A large-scale analysis of tendon ruptures revealed that only 6% of ruptures involved the patellar tendon. Most patellar tendon ruptures occur in older individuals, with a mean age of 65 years. All patients with patellar tendon ruptures had pre-existing tendon pathology. Since this is an uncommon injury, it will not be discussed further in this review.

Aetiology

The exact pathoaetiology of tendinopathy remains unclear, with several models proposed to explain its development(Cook & Purdam, 2009). Among these, the continuum model of tendinopathy has the strongest clinical correlation.[7] This model categorizes tendon pathology into three interrelated stages: reactive tendinopathy, tendon dysrepair, and degenerative tendinopathy. These stages are not necessarily linear, and tendons often exhibit a combination of pathological states. For instance, a degenerative patellar tendon with a localized degenerative area may lack sufficient structural integrity to bear loads, resulting in overload and reactive tendinopathy in adjacent, non-degenerative regions.

The ability of tendon pathology to progress and regress along the continuum has been demonstrated in the patellar tendons of basketball players. Players underwent monthly ultrasound imaging during the season, and it was observed that tendons with reactive tendinopathy and tendon dysrepair could both progress (to degenerative tendinopathy) and regress (to a normal tendon state) over the course of the season. While imaging abnormalities are not always indicative of painful patellar tendinopathy, certain imaging findings, such as large hypoechoic regions on ultrasound, may increase the likelihood of developing the condition(Comin et al., 2013).

The age at which patellar tendons become susceptible to pathology remains unclear, although such pathology has been observed in young athletes. Evidence indicates that tendon tissue becomes inert and ceases to renew after the age of 17, suggesting that tendon structure remains relatively stable once formed during puberty. Support for early onset of patellar tendinopathy is provided by findings that only two players developed the condition after the age of 16 in a cohort of talented volleyball players.

The mechanisms underlying tendon pain appear to be partially independent of tendon pathology. Although pathological tendons are often associated with pain, pain has also been observed in tendons that appear normal(Heinemeier et al., 2013). Overload is frequently reported as a critical factor in pain onset(Gisslén et al., 2007). Overload is defined as activity exceeding the tendon's adaptive capacity at a given time. This can

occur due to a sudden, significant increase in jumping volume or a return to regular activity following injury or inactivity without adequate progression. Energy storage and release loads, such as those in jumping or changes in direction, are typical overload patterns leading to patellar tendinopathy pain. Non-energy storage activities, such as cycling or swimming, and repetitive low loading, as seen in running, rarely provoke patellar tendon symptoms; alternative diagnoses should be considered in these cases.

Risk and Associated Factors

Research has examined both intrinsic and extrinsic factors associated with the risk of developing pathology or patellar tendinopathy. It is important to distinguish between risk factors for pathology and those for pain, as they may differ. While this section does not address biomechanical studies of painful tendons—since altered mechanics may result from pain—these factors are relevant to treatment considerations.

Extrinsic Factors

An increase in training volume and frequency is a common trigger for patellar tendinopathy, as evidenced by several studies(Janssen et al., 2014; Visnes & Bahr, 2013). Clinically, this is the most frequently observed cause. Other factors, such as changes in surface density and shock absorption, may also play a role. While harder surfaces can exacerbate symptoms this is less relevant today as most indoor sports are conducted on standardized sprung wooden floors. Nonetheless, surface properties and shock absorption in footwear and training surfaces remain important considerations, particularly when athletes train on hard floors, athletic tracks, or surfaces with high horizontal traction.

Intrinsic Factors

Numerous studies have explored anthropometric characteristics potentially linked to patellar tendinopathy symptoms, including height, weight, lower limb joint range of motion, leg length, body composition, lower limb alignment, and the length and strength of the hamstrings and quadriceps. Shorter or less extensible quadriceps and hamstrings have been associated with patellar tendinopathy,(Crossley et al., 2007) while greater strength has been correlated with reduced pain and better function. However, superior knee extensor strength and jumping ability have also been observed in athletes with patellar tendinopathy, especially in activities involving energy storage. Additionally, young women with tendon pathology have demonstrated better vertical jump performance compared to their asymptomatic counterparts(Visnes & Bahr, 2013). Clinical observations align with these findings, suggesting that patellar tendinopathy is more prevalent in athletes with superior jumping capabilities.

Different lower limb kinematics and muscle recruitment patterns during the horizontal landing phase have been linked to tendon pathology. Edwards et al. found that horizontal braking forces place the highest loads on the patellar tendon, with contributions from patellofemoral joint compression, patellar tendon compression, and tensile loading during knee flexion, particularly in individuals with asymptomatic tendon pathology(Edwards et al., 2010).

Other intrinsic factors, including lower foot arch height, limited ankle dorsiflexion,greater leg length discrepancy, and patella alta in men, have been associated with patellar tendinopathy. Boys and men are two to four times more likely to develop the condition than girls(Visnes & Bahr, 2013). Increased waist circumference in men has also been linked to a higher prevalence of pathology on ultrasound. Men with a waist circumference exceeding 83 cm are more likely to show abnormal imaging changes (74% vs. 15% in those with smaller circumferences)(Malliaras et al., 2007). Studies have also found that athletes with patellar tendinopathy tend to be younger, taller, and heavier than their asymptomatic counterparts, while the infrapatellar fat pad is notably larger in those with tendinopathy compared to controls(Culvenor et al., 2011).

Assessment

History

There is limited evidence regarding assessment procedures for patellar tendinopathy; thus, this section is informed by expert opinion. As with any musculoskeletal condition, obtaining a detailed history is critical to identify whether the tendon is the source of pain. Initially, this involves asking the patient to localize their pain during a patellar tendon-loading task (e.g., jumping or changing direction) by pointing with one finger to the tendon attachment at the patella. Pain that is more diffusely distributed should prompt consideration of alternative diagnoses. Additionally, the history should explore potential reasons for the tendon becoming painful, with tendon overload being the most common cause. Two primary overload scenarios are observed: a substantial increase in overall load from a stable baseline (e.g., initiating plyometric training or participating in a high-volume tournament) or a return to usual training after a period of inactivity (e.g., resuming activity after 4–6 weeks off due to an ankle sprain or holiday). In elite athletes, repeated cycles of loading and unloading due to injuries or season breaks can gradually diminish the tendon's load tolerance, increasing its vulnerability to overload with minor training adjustments.

Classic pain behaviors include soreness at the onset of activity, variable response to warm-up (ranging from complete relief to no effect), and worsening symptoms the following day, which may persist for several days. Night pain and morning stiffness are rarely reported unless symptoms are severe. Pain with prolonged sitting, particularly in a car, is a common complaint and can serve as a useful reassessment marker during recovery. Daily activities, such as climbing stairs and squatting, are also frequently provocative.

Athletes with patellar tendinopathy often describe themselves as good power athletes, excelling in jumping and quick directional changes(Visnes et al., 2013). They frequently report that tendon pain impairs their performance, reducing their ability to perform at a high level.

A thorough history should document all prior treatments and interventions, including detailed descriptions of successful and unsuccessful strategies, as well as specifics of exercise programs (e.g., repetitions, sets, weights, and frequency). Many patients consult multiple healthcare providers, and inconsistent care can prolong rehabilitation. The history should also include known risk factors for tendinopathy, such as diabetes, high cholesterol, seronegative arthropathies, and the use of fluoroquinolones, although their role in patellar tendinopathy remains unclear. Lastly, the clinician should inquire about previous injuries or medical conditions that may have necessitated reduced loading or altered the athlete's movement patterns, potentially contributing to the condition.

Examination

The Victorian Institute of Sports Assessment for the Patellar Tendon (VISA-P) should be utilized as a baseline measure to monitor both pain and function over time. The VISA-P is a concise questionnaire evaluating symptoms, simple functional tests, and sports participation capacity. Six of the eight items are scored using a visual analogue scale (VAS) from 0 to 10, where 10 indicates optimal health. The highest possible score for a fully functional, asymptomatic athlete is 100 points, with the lowest being 0; a score below 80 is indicative of dysfunction. The tool has high reliability, and it is recommended to repeat assessments monthly, with a minimum clinically significant change identified as 13 points(Hernandez-Sanchez et al., 2014). Tenderness during palpation is not a reliable diagnostic technique and should not be used as an outcome measure however, algometry measurements indicate that athletes with patellar tendinopathy exhibit significantly lower pain pressure thresholds (36.8 N) compared to healthy counterparts.

Observation typically reveals muscle atrophy in the quadriceps and calf, particularly the gastrocnemius, on the affected side compared to the contralateral limb. The degree of atrophy generally corresponds to the duration of symptoms. Even elite athletes who continue to train and compete may experience reductions in muscle bulk and strength due to pain-induced unloading.

Clinical Tests

The single-leg decline squat is a critical diagnostic tool. The patient, while standing on the affected leg on a 25-degree decline board, maintains an upright posture and attempts to squat to a knee flexion angle of up to 90 degrees (if possible). The procedure is repeated on the unaffected leg, and for each leg, the maximum knee flexion angle achieved, and the associated pain (rated on a VAS) are recorded. Diagnostic pain is typically localized to the tendon-bone junction and does not spread during the test(Kountouris & Cook, 2007). This test is also valuable for self-assessment, allowing daily monitoring of tendon load response.

Kinetic chain function is often impaired, presenting as stiff knee movement and reduced elasticity at the ankle and hip. Single-leg hop tests and specific change-of-direction drills can assess movement quality, with pain and function recorded during takeoff and landing phases. For elite athletes, video or biomechanical analysis may further aid in evaluating joint angles and moments. Additionally, hop tests for height and distance serve as functional indicators of kinetic chain quality and can track rehabilitation progress.

Strength assessments, including repeated calf raises and decline squats, are essential to evaluate muscle unloading levels. Ankle dorsiflexion range of motion is particularly important, as the ankle and calf play crucial roles in energy absorption during landing(Fong et al., 2011). Restrictions in talocrural dorsiflexion, general foot stiffness, or hallux rigidus can increase the load on the musculotendinous units of the leg.

Imaging

Traditional ultrasound and magnetic resonance imaging (MRI) can detect tendon pathology. Emerging techniques such as ultrasound tissue characterization allow quantification of tendon disorganization and may provide additional insights.35 However, imaging will almost always reveal abnormalities in symptomatic individuals, regardless of modality. Pathology identified via imaging is not necessarily the source of pain, making clinical correlation essential. Tendon pathology is often degenerative and circumscribed, showing minimal change over time. Thus, imaging as an outcome measure is limited, as pain may improve without corresponding structural changes(Docking et al., 2012). In sports like volleyball, where high tendon loads are routine, imaging abnormalities are common and must be interpreted cautiously in conjunction with clinical findings.

Differential Diagnosis

Comprehensive history-taking and examination are critical to differentiate patellar tendinopathy from other conditions, such as patellofemoral pain syndrome, plica or fat pad pathology, patellar subluxation or tracking issues, and Osgood-Schlatter disease.

Physiotherapy Management

Although complete resolution of patellar tendon pathology may not always be achievable, symptoms of patellar tendinopathy can generally be managed conservatively. This section outlines therapeutic interventions based on research, clinical experience, and emerging evidence.

Active Interventions

Management focuses on alleviating pain initially, followed by a structured progressive resistive exercise program to address strength deficits, improve stretch-shortening cycle capacity, and facilitate a functional return to sport. Monitoring pain through daily single-leg decline squats provides valuable feedback on tendon load tolerance, with stable or improving scores indicating adequate adaptation to loading.

Pain Reduction

Reducing symptoms necessitates strategic load management without completely ceasing tendon-loading activities, as complete rest can further reduce tendon capacity. Adjusting training by removing high-load drills, reducing training frequency (e.g., twice weekly), or decreasing training volume can effectively manage tendon load while avoiding deconditioning.

Sustained isometric contractions have shown analgesic effects in cases of painful patellar tendinopathy, typically involving reactive or reactive-on-degenerative pathology. Performing voluntary contractions at 70% of maximum strength, held for 45–60 seconds and repeated four times, can yield significant hypoalgesic effects lasting 2–8 hours(Cook & Purdam, 2014; Naugle et al., 2012). These contractions can be performed pre-game, pre-training, or multiple times daily. For highly irritable tendons, bilateral exercises, shorter hold times, and fewer repetitions are recommended. Pain relief may also be augmented with medications, warranting consultation with a physician(Fallon et al., 2008).

Strengthening

Eccentric, heavy slow resistance, isotonic, and isometric exercises have been extensively studied for patellar tendinopathy management. Eccentric training demonstrates both short-term and long-term benefits for symptoms and VISA-P scores. Various eccentric loading protocols exist, though outcomes between bilateral weighted squats and unilateral decline squats over a 12-week period are comparable.

The single-leg decline squat at a 25-degree angle yields superior outcomes compared to flat-surface squats. Angles above 15 degrees appear effective,(Richards et al., 2008) with the decline board enhancing the knee’s moment arm. However, during competitive seasons, eccentric training may not be beneficial. For instance, Visnes et al observed no functional improvement and transient symptom exacerbation in symptomatic athletes who continued regular training alongside eccentric exercises. Fredberg et al reported an increased injury risk in asymptomatic athletes with ultrasonographic pathology who performed prophylactic eccentric exercises(Fredberg et al., 2008).

Heavy slow resistance training was investigated by Kongsgaard et al, who compared corticosteroid injections, eccentric decline squats, and heavy slow resistance exercises. At 12 weeks, all groups showed symptom improvements, but at six months, only the exercise groups-maintained gains in VISA-P and VAS scores. The heavy slow resistance protocol was associated with better tendon collagen normalization and superior clinical outcomes compared to eccentrics(Kongsgaard et al., 2009).

Combined protocols incorporating eccentric, concentric, and plyometric exercises, as studied by Silbernagel et al for Achilles tendinopathy, allow continued sports participation if pain does not exceed 5/10 during activity and resolves by the following day. While initially studied in the Achilles tendon, this approach is often clinically applied to patellar tendinopathy and warrants consideration.

Functional Strengthening and Return to Sports

Functional strengthening programs should focus on enhancing both high-load tendon capacity and addressing kinetic chain deficits and movement patterns. Once these components have been optimized, the athlete can transition to sports-specific training. Progressive loading should incorporate faster contractions to prepare the tendon for the stretch-shortening cycle, which is essential for returning to sports. Initial drills may include skipping, jumping, and hopping, progressing to agility exercises, changes in direction, sprinting, and bounding movements. These tasks should be quantified, employing a high-low-medium load distribution during the early phases of reintroducing high-load activities and sports participation. Additionally, training should be tailored to the specific demands of the athlete's sport, incorporating movement assessments to optimize kinetic chain loading.

Passive Interventions

Certain passive interventions may complement an active exercise program, though evidence for their efficacy in treating patellar tendinopathy remains limited. Comparative studies between exercise, pulsed ultrasound, and transverse friction massage indicate that exercise produces superior short- and long-term outcomes. Manual therapy techniques, such as myofascial manipulation targeting the knee extensor muscle group, have demonstrated effectiveness in reducing pain in both short- and long-term follow-up studies(Pedrelli et al., 2009). Braces and taping are commonly employed in clinical practice to offload the patellar tendon, but their efficacy lacks supporting evidence. Passive treatments are best suited to alleviate symptoms during the competitive season, enabling the athlete to continue rehabilitation and participate in sports.

Other Interventions

Extracorporeal shockwave therapy (ESWT), corticosteroid injections, platelet-rich plasma (PRP), and other injection-based treatments are frequently utilized clinically but lack robust evidence for their efficacy in patellar tendinopathy. Studies have shown no significant benefits of ESWT compared to placebo in athletes with chronic patellar tendinopathy during the competitive season(Zwerver et al., 2011). Comparisons between PRP and ESWT revealed that while PRP demonstrated superior outcomes at 6- and 12-month follow-ups, both groups exhibited similar improvements at 2 months(Vetrano et al., 2013). Peritendinous corticosteroid injections, oral steroidal medication, or iontophoresis can rapidly reduce cellular responses and pain in reactive tendons, but long-term outcomes with these treatments are generally inferior to those achieved through exercise. Corticosteroid injections are contraindicated in cases of degenerative tendinopathy. Analgesic injections, while potentially helpful for pain relief, may impair the athlete's ability to regulate activity and lead to poorer long-term outcomes; they are not recommended during the competitive season.

The efficacy of PRP injections in tendinopathy remains unclear, with some studies reporting limited benefits(De Vos et al., 2010). A 2011 review of injection-based treatments highlighted positive outcomes in small-sample studies, emphasizing the need for further research(Van Ark et al., 2011). Surgical options, including arthroscopic shaving and sclerosing injections, have shown promise in reducing pain and downtime from sports. Surgical decisions should consider the tendinopathy stage and integrate with a comprehensive rehabilitation program addressing kinetic chain exercises, landing mechanics, load management, and sports reintroduction.

Education

Educating athletes on the rehabilitation process is essential for setting realistic expectations. Athletes should understand that symptom management is a lifelong requirement, irrespective of their recreational or professional level. They must be equipped to monitor symptoms, adjust participation, and modify loading appropriately during rehabilitation and upon returning to sports. Strengthening exercises should be maintained twice weekly throughout their sporting careers.

Tendons exhibit a delayed pain response to load, often presenting minimal discomfort during activity but flaring 24 hours later. Regular pain monitoring is crucial for guiding and progressing rehabilitation and should continue post-return to sport. The single-leg decline squat is an effective self-assessment tool, allowing athletes to monitor symptoms and their response to rehabilitation and sports participation. Maintaining a symptom journal detailing pain levels during decline squats can help identify triggers, monitor load responses, and facilitate independent symptom management.

Factors Affecting Prognosis

The timeline for returning to sports is influenced by pain severity, dysfunction, rehabilitation quality, and intrinsic and extrinsic factors. Mild tendon pathology is associated with a mean rehabilitation period of 20 days, whereas severe pathology may require approximately 90 days. However, imaging-based guidelines may underestimate the actual recovery time due to other prognostic factors. Significant kinetic chain dysfunction, irrespective of pain levels, necessitates extended rehabilitation (6–12 months) to restore muscle and tendon capacity. Athletes aiming for high-performance levels, such as elite high jumpers, will require more extensive rehabilitation compared to recreational athletes, reflecting the differing physical demands. Similarly, the load on the patellar tendon varies within elite sports; for example, volleyball players face greater demands than basketball players and may require longer recovery times. Despite these variations, impatience with rehabilitation typically results in worse outcomes. Effective rehabilitation combined with a gradual return to sports remains the optimal approach.

Factors Affecting Response to Therapy

The mechanisms underlying pain in tendinopathies are not fully understood, though evidence suggests a role for central sensitization and upregulation of the central nervous system(Rio et al., 2014). A small study found that athletes with patellar tendinopathy have lower mechanical pain thresholds and heightened vibration sensitivity compared to non-injured athletes(van Wilgen et al., 2013). Local factors, such as neovascularization, lack sufficient evidence as primary drivers of pain, which remains an area for further investigation.

Conclusion

Patellar tendinopathy, or jumper's knee, is a multifaceted condition that significantly impacts the health and performance of athletes. Despite advances in research, challenges persist in understanding the pathoaetiology, accurately diagnosing, and effectively treating the condition. Comprehensive management involves a combination of evidence-based active interventions, functional strengthening, and education to empower athletes to monitor and adapt their rehabilitation strategies. Passive and surgical treatments may play adjunctive roles, but their effectiveness is limited compared to tailored exercise programs. Long-term outcomes hinge on consistent symptom management, adherence to rehabilitation protocols, and gradual return-to-sport plans. Further research into the underlying mechanisms of pain and the efficacy of emerging therapies is crucial to optimize treatment strategies for patellar tendinopathy.

References

Clarsen, B., Myklebust, G., & Bahr, R. (2013). Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: The Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire. *British Journal of Sports Medicine*, *47*(8), 495–502. Scopus. https://doi.org/10.1136/bjsports-2012-091524

Comin, J., Cook, J. L., Malliaras, P., McCormack, M., Calleja, M., Clarke, A., & Connell, D. (2013). The prevalence and clinical significance of sonographic tendon abnormalities in asymptomatic ballet dancers: A 24-month longitudinal study. *British Journal of Sports Medicine*, *47*(2), 89–92. Scopus. https://doi.org/10.1136/bjsports-2012-091303

Cook, J. L., Khan, K. M., Harcourt, P. R., Kiss, Z. S., Fehrmann, M. W., Griffiths, L., & Wark, J. D. (2018). Patellar tendon ultrasonography in asymptomatic active athletes reveals hypoechoic regions: A study of 320 tendons. *Clinical Journal of Sport Medicine*, *8*(2), 73–77. Scopus. https://doi.org/10.1097/00042752-199804000-00001

Cook, J. L., Khan, K. M., Kiss, Z. S., & Griffiths, L. (2000). Patellar tendinopathy in junior basketball players: A controlled clinical and ultrasonographic study of 268 patellar tendons in players aged 14-18 years. *Scandinavian Journal of Medicine and Science in Sports*, *10*(4), 216–220. Scopus. https://doi.org/10.1034/j.1600-0838.2000.010004216.x

Cook, J. L., & Purdam, C. R. (2009). Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy. *British Journal of Sports Medicine*, *43*(6), 409–416. Scopus. https://doi.org/10.1136/bjsm.2008.051193

Cook, J. L., & Purdam, C. R. (2014). The challenge of managing tendinopathy in competing athletes. *British Journal of Sports Medicine*, *48*(7), 506–509. Scopus. https://doi.org/10.1136/bjsports-2012-092078

Crossley, K. M., Thancanamootoo, K., Metcalf, B. R., Cook, J. L., Purdam, C. R., & Warden, S. J. (2007). Clinical features of patellar tendinopathy and their implications for rehabilitation. *Journal of Orthopaedic Research*, *25*(9), 1164–1175. Scopus. https://doi.org/10.1002/jor.20415

Culvenor, A. G., Cook, J. L., Warden, S. J., & Crossley, K. M. (2011). Infrapatellar fat pad size, but not patellar alignment, is associated with patellar tendinopathy. *Scandinavian Journal of Medicine and Science in Sports*, *21*(6), e405–e411. Scopus. https://doi.org/10.1111/j.1600-0838.2011.01334.x

De Vos, R. J., Weir, A., Van Schie, H. T. M., Bierma-Zeinstra, S. M. A., Verhaar, J. A. N., Weinans, H., & Tol, J. L. (2010). Platelet-rich plasma injection for chronic Achilles tendinopathy: A randomized controlled trial. *JAMA*, *303*(2), 144–149. Scopus. https://doi.org/10.1001/jama.2009.1986

Docking, S. I., Daffy, J., van Schie, H. T. M., & Cook, J. L. (2012). Tendon structure changes after maximal exercise in the Thoroughbred horse: Use of ultrasound tissue characterisation to detect in vivo tendon response. *Veterinary Journal*, *194*(3), 338–342. Scopus. https://doi.org/10.1016/j.tvjl.2012.04.024

Edwards, S., Steele, J. R., McGhee, D. E., Beattie, S., Purdam, C., & Cook, J. L. (2010). Landing strategies of athletes with an asymptomatic patellar tendon abnormality. *Medicine and Science in Sports and Exercise*, *42*(11), 2072–2080. Scopus. https://doi.org/10.1249/MSS.0b013e3181e0550b

Fallon, K., Purdam, C., Cook, J., & Lovell, G. (2008). A “polypill” for acute tendon pain in athletes with tendinopathy? *Journal of Science and Medicine in Sport*, *11*(3), 235–238. Scopus. https://doi.org/10.1016/j.jsams.2007.09.002

Fong, C.-M., Blackburn, J. T., Norcross, M. F., McGrath, M., & Padua, D. A. (2011). Ankle-dorsiflexion range of motion and landing biomechanics. *Journal of Athletic Training*, *46*(1), 5–10. Scopus. https://doi.org/10.4085/1062-6050-46.1.5

Fredberg, U., Bolvig, L., & Andersen, N. T. (2008). Prophylactic training in asymptomatic soccer players with ultrasonographic abnormalities in Achilles and patellar tendons: The Danish super league study. *American Journal of Sports Medicine*, *36*(3), 451–460. Scopus. https://doi.org/10.1177/0363546507310073

Gisslén, K., Gyulai, C., Nordström, P., & Alfredson, H. (2007). Normal clinical and ultrasound findings indicate a low risk to sustain jumper’s knee patellar tendinopathy: A longitudinal study on Swedish elite junior volleyball players. *British Journal of Sports Medicine*, *41*(4), 253–258. Scopus. https://doi.org/10.1136/bjsm.2006.029488

Heinemeier, K. M., Schjerling, P., Heinemeier, J., Magnusson, S. P., & Kjaer, M. (2013). Lack of tissue renewal in human adult Achilles tendon is revealed by nuclear bomb 14C. *FASEB Journal*, *27*(5), 2074–2079. Scopus. https://doi.org/10.1096/fj.12-225599

Hernandez-Sanchez, S., Hidalgo, M. D., & Gomez, A. (2014). Responsiveness of the VISA-P scale for patellar tendinopathy in athletes. *British Journal of Sports Medicine*, *48*(6), 453–457. Scopus. https://doi.org/10.1136/bjsports-2012-091163

Janssen, I., Steele, J. R., Munro, B. J., & Brown, N. A. T. (2014). Sex differences in neuromuscular recruitment are not related to patellar tendon load. *Medicine and Science in Sports and Exercise*, *46*(7), 1410–1416. Scopus. https://doi.org/10.1249/MSS.0000000000000252

Kongsgaard, M., Kovanen, V., Aagaard, P., Doessing, S., Hansen, P., Laursen, A. H., Kaldau, N. C., Kjaer, M., & Magnusson, S. P. (2009). Corticosteroid injections, eccentric decline squat training and heavy slow resistance training in patellar tendinopathy. *Scandinavian Journal of Medicine and Science in Sports*, *19*(6), 790–802. Scopus. https://doi.org/10.1111/j.1600-0838.2009.00949.x

Kountouris, A., & Cook, J. (2007). Rehabilitation of Achilles and patellar tendinopathies. *Best Practice and Research: Clinical Rheumatology*, *21*(2), 295–316. Scopus. https://doi.org/10.1016/j.berh.2006.12.003

Malliaras, P., Cook, J. L., & Kent, P. M. (2007). Anthropometric risk factors for patellar tendon injury among volleyball players. *British Journal of Sports Medicine*, *41*(4), 259–263. Scopus. https://doi.org/10.1136/bjsm.2006.030049

Naugle, K. M., Fillingim, R. B., & Riley III, J. L. (2012). A meta-analytic review of the hypoalgesic effects of exercise. *Journal of Pain*, *13*(12), 1139–1150. Scopus. https://doi.org/10.1016/j.jpain.2012.09.006

Pedrelli, A., Stecco, C., & Day, J. A. (2009). Treating patellar tendinopathy with Fascial Manipulation. *Journal of Bodywork and Movement Therapies*, *13*(1), 73–80. Scopus. https://doi.org/10.1016/j.jbmt.2008.06.002

Richards, J., Thewlis, D., Selfe, J., Cunningham, A., & Hayes, C. (2008). A biomechanical investigation of a single-limb squat: Implications for lower extremity rehabilitation exercise. *Journal of Athletic Training*, *43*(5), 477–482. Scopus. https://doi.org/10.4085/1062-6050-43.5.477

Rio, E., Moseley, L., Purdam, C., Samiric, T., Kidgell, D., Pearce, A. J., Jaberzadeh, S., & Cook, J. (2014). The pain of tendinopathy: Physiological or pathophysiological? *Sports Medicine*, *44*(1), 9–23. Scopus. https://doi.org/10.1007/s40279-013-0096-z

Van Ark, M., Zwerver, J., & Van Den Akker-Scheek, I. (2011). Injection treatments for patellar tendinopathy. *British Journal of Sports Medicine*, *45*(13), 1068–1076. Scopus. https://doi.org/10.1136/bjsm.2010.078824

van Wilgen, C. P., Konopka, K. H., Keizer, D., Zwerver, J., & Dekker, R. (2013). Do patients with chronic patellar tendinopathy have an altered somatosensory profile? - A Quantitative Sensory Testing (QST) study. *Scandinavian Journal of Medicine and Science in Sports*, *23*(2), 149–155. Scopus. https://doi.org/10.1111/j.1600-0838.2011.01375.x

Vetrano, M., Castorina, A., Vulpiani, M. C., Baldini, R., Pavan, A., & Ferretti, A. (2013). Platelet-rich plasma versus focused shock waves in the treatment of Jumper's knee in athletes. *American Journal of Sports Medicine*, *41*(4), 795–803. Scopus. https://doi.org/10.1177/0363546513475345

Visnes, H., Aandahl, H. Å., & Bahr, R. (2013). Jumper's knee paradox - Jumping ability is a risk factor for developing jumper's knee: A 5-year prospective study. *British Journal of Sports Medicine*, *47*(8), 503–507. Scopus. https://doi.org/10.1136/bjsports-2012-091385

Visnes, H., & Bahr, R. (2013). Training volume and body composition as risk factors for developing jumper 's knee among young elite volleyball players. *Scandinavian Journal of Medicine and Science in Sports*, *23*(5), 607–613. Scopus. https://doi.org/10.1111/j.1600-0838.2011.01430.x

Zwerver, J., Hartgens, F., Verhagen, E., Van Der Worp, H., Van Den Akker-Scheek, I., & Diercks, R. L. (2011). No effect of extracorporeal shockwave therapy on patellar tendinopathy in jumping athletes during the competitive season: A randomized clinical trial. *American Journal of Sports Medicine*, *39*(6), 1191–1199. Scopus. https://doi.org/10.1177/0363546510395492