

Clinical Management of Patellar Tendinopathy

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Patellar tendinopathy is a common yet misunderstood condition that afflicts a variety of patient populations. This lack of understanding affects the ability of clinicians to provide effective treatment interventions. Patients with tendinopathy often report long-term and low to moderate levels of pain, diminished flexibility, and reduced strength, as well as decreased physical function. Load-management strategies combined with exercise

regimens focused on progressive tendon loading are the most effective treatment options for patients with patellar tendinopathy. This review will provide an evidence-based approach to patellar tendinopathy, including its pathoetiology, evaluation, and treatment strategies.

Key Words: tendinitis, tendon, tendinosis, load management, exercise, loading

Patellar tendinopathy accounts for approximately 10% of clinical knee diagnoses, making it one of the most common knee pathologies.^{1,2} Patellar tendinopathy occurs in physically active populations of all ages; the subsequent pain forces many athletes to limit or discontinue sport participation. Historically, *patellar tendinitis*, or “jumper’s knee,” has been used colloquially to characterize anterior knee symptoms experienced in the quadriceps tendon, patellar tendon, or both, which suggests that this condition affects only those participating in jumping sports (eg, basketball and volleyball).³ However, any individuals who participate in activities that cause loading of the patellar tendon through rapid acceleration or deceleration, frequent change of direction, repetitive movements, or any combination of these are at risk for symptoms originating from the patellar tendon.⁴

Contemporary theory and histopathologic examinations suggest that the term *tendinitis* may be inaccurate, as the condition often presents with tissue degeneration rather than an acute inflammatory response.⁵ However, this is disputed in the literature, with some groups^{6,7} demonstrating active inflammation in chronic pathologic tendons. Nonetheless, *tendinopathy* is an umbrella term that encompasses tendon degeneration with failed healing due to tissue overload without adequate recovery.⁵ The term *tendinopathy*, as opposed to *tendinitis* or *tendinosis*, is recommended when discussing overuse conditions related to the patellar tendon unless histologically confirmed via tissue biopsy.⁵ The poor understanding of the underlying pathology contributing to patellar tendinopathy diminishes our ability to provide effective treatments.⁸ Therefore, the purpose of this current clinical concepts article is to present the practicing clinician with a comprehensive, evidence-based approach to the evaluation and treatment of patients with patellar tendinopathy. Interventions that bridge the gap from load-reduction management strategies to unrestricted sport participation are described. When possible, we used

the Strength of Recommendation (SOR) Taxonomy to grade the strength of evidence (A, B, or C).⁹

EPIDEMIOLOGY

In a general practice adult population, lower extremity tendinopathies had a prevalence rate of 10.5 per 1000 person-years, with a patellar tendinopathy incidence of 1.6 per 1000 person-years.¹⁰ Injuries to the patella and patellar tendon account for almost 30% of knee structure injuries among high school athletes across a variety of sports, including soccer, running, volleyball, basketball, and ice hockey.¹¹ Patellar tendinopathy reaches incidence proportions of 32% and 45% in elite basketball and volleyball athletes, respectively.¹² Among recreational runners, patellar tendinopathy was the third most common condition behind patellofemoral pain syndrome and iliotibial band friction syndrome.¹³ Men may experience higher rates of patellar tendinopathy than women, despite anterior knee pain such as patellofemoral pain syndrome being more prevalent in women.⁴ Those who suffer from patellar tendinopathy are often younger (<20 years of age) and have a greater body mass index than those without the condition.^{4,11}

PATHOPHYSIOLOGY

The pathologic sequence of patellar tendinopathy and factors contributing to resulting pain and disability remain poorly understood and are often disputed. Tendons generally have a poorer blood supply than muscles. The blood supply of the patellar tendon emanates directly from the infrapatellar fat pad and retinaculum.^{14,15} Notably, the patellar tendon has areas of reduced vascularity, especially at the proximal and distal attachments, which are frequently linked to degeneration and failure.¹⁵ Stress shielding and compression may also contribute to tendon strain during movement.¹⁶ Histopathologic findings typically suggest

chronic, mucoid degeneration rather than an acute inflammatory response.⁵ Pathologic tendons demonstrate a higher concentration of type III collagen, in comparison with primarily type I collagen in healthy tendon tissue.⁷ When viewed both macroscopically and microscopically, the affected areas of the tendons' collagen fibers appear thinner and disorganized, with associated fibrosis.⁷ At the cellular level, changes include hypercellularity characterized by cell proliferation and increased fibroblast activity.⁷ *Neovascularization*, or abnormal vascular proliferation, along with an increased concentration of proteoglycans and water content, is also present.⁷ These pathologic responses suggest an attempt by the tendon to heal itself⁷ and lead to the often-observed increase in tendon thickness that typically characterizes patellar tendinopathy.⁷

A primary contributor to patellar tendinopathy is likely mechanical overloading of the quadriceps muscle, resulting in tensile failure of the collagen fibers within the patellar tendon.⁷ Repetitive tensile stresses within the patellar tendon without adequate recovery may cause microtrauma with insufficient opportunities for tissue adaptation and healing.⁷ The damage caused by excessive submaximal tensile strain weakens portions of the tendon and reduces its ability to transfer forces from the quadriceps muscle.¹⁷ This presents clinically as quadriceps muscle weakness.

RISK FACTORS

Repetitive activities that load the patellar tendon, often in combination with variations in training behavior, are a primary risk factor for the development of patellar tendinopathy.¹⁸ Patients with patellar tendinopathy demonstrate significantly higher total training volumes, previous training volumes, and match exposures compared with their healthy counterparts.¹⁸ Further, a recent meta-analysis¹⁸ indicated that higher body weight was associated with patellar tendinopathy (odds ratio = 1.92). However, despite speculation to the contrary, the type of playing surface was not a significant risk factor for patellar tendinopathy.¹⁸

The development and perpetuation of patellar tendinopathy has also been linked to alterations in muscle strength, range of motion, and static lower extremity alignment. Patients with patellar tendinopathy had decreased quadriceps strength and ankle-dorsiflexion range of motion.^{18,19} In a retrospective study, Taunton et al² found that 27% of those with patellar tendinopathy displayed static genu valgum alignment, a potential mechanical contributor to tendinopathy. Quadriceps and hamstrings muscle strength and flexibility, pelvic tilt, and the Q-angle have all been associated with the level of self-reported disability in patients with patellar tendinopathy.²⁰

From a biomechanical perspective, decreased sagittal-plane motion of the hip and knee during movement has been associated with the development and perpetuation of patellar tendinopathy.²¹ Individuals with patellar tendinopathy exhibited decreased external knee-extension moments compared with control participants during jump landings.²² However, whether these changes in biomechanics and movement patterns contribute to the onset of patellar tendinopathy or instead develop secondary to the onset of the condition is unclear.

SIGNS, SYMPTOMS, AND PHYSICAL EXAMINATION

Patients with patellar tendinopathy report localized anterior knee pain at the patellar tendon. The onset of pain is typically insidious and related to increases in both the frequency and intensity of patellar tendon-loading activity. In the early stages, patients may report pain at the beginning of exercise that diminishes with continued activity.⁷ In more advanced stages, anterior knee pain may be present throughout exercise and result in reduced activity.⁷ Further, patients may report pain during activities of daily living, including pain during long periods of sitting and stair ascent and descent.⁷

Focal point tenderness is the most prevalent finding on physical examination.^{23,24} Although the patellar tendon may be tender throughout, the inferior pole and distal insertion at the tibial tuberosity are the most common areas of tenderness.²³ As part of a clinical assessment, palpation was statistically reliable both between and within raters; however, sensitivity was moderate and specificity was poor when compared with ultrasound imaging.²³ Abnormal ultrasound findings in the patellar tendon are frequent in asymptomatic individuals and may contribute to the poor diagnostic accuracy of palpation.²⁵ Similarly, providing the patient with an image on which to pinpoint the pain location (pain mapping) may assist clinical assessment.²⁴ In particular, pain mapping during a single-legged squat in comparison with pain at rest may provide useful information regarding a variety of knee conditions, including the differentiation of patellar tendinopathy if pain is mapped to the patellar tendon.²⁴ Pain may occur during resisted knee extension or other forms of high loading of the patellar tendon (eg, descending stairs, decline walking). *SOR: A*

Other useful functional performance tests for patients with patellar tendinopathy involve jumping and jump landing. The maximum vertical jump is the most assessed functional test in the literature related to patellar tendinopathy.¹⁸ However, the evidence is conflicting, with some authors¹⁸ reporting that those with patellar tendinopathy had better vertical jump performance than healthy control participants. The single-legged hop for distance and 6-m hop test may also be useful as part of a test battery to assess function and performance over time.²⁶ Balance examinations may provide insight relating patient symptoms to function in patellar tendinopathy, as increases in pain are associated with worse dynamic postural stability.²⁷ *SOR: B*

Symptoms associated with patellar tendinopathy have both short- and long-term outcomes. Symptom duration averages 19 months and can exceed 32 months in elite athletes.¹¹ The most common outcome associated with patellar tendon injuries is loss of participation.²⁸ In 1 long-term prospective study²⁸ of male athletes, 53% of those with patellar tendinopathy indicated they ended their sports career because of the symptoms and their effects on physical function. Many of those athletes who continued to participate in their sports experienced mild but persistent symptoms that remained after their athletic careers ended.²⁸

The main differential diagnosis of patellar tendinopathy is *patellofemoral pain syndrome*, defined as a form of nonspecific, nonstructural knee pain around or behind the patella.²⁹ Patellofemoral pain syndrome is characterized by crepitus or “grinding” underneath the patella during knee flexion and tenderness along the patellar facets.²⁹ Patellar

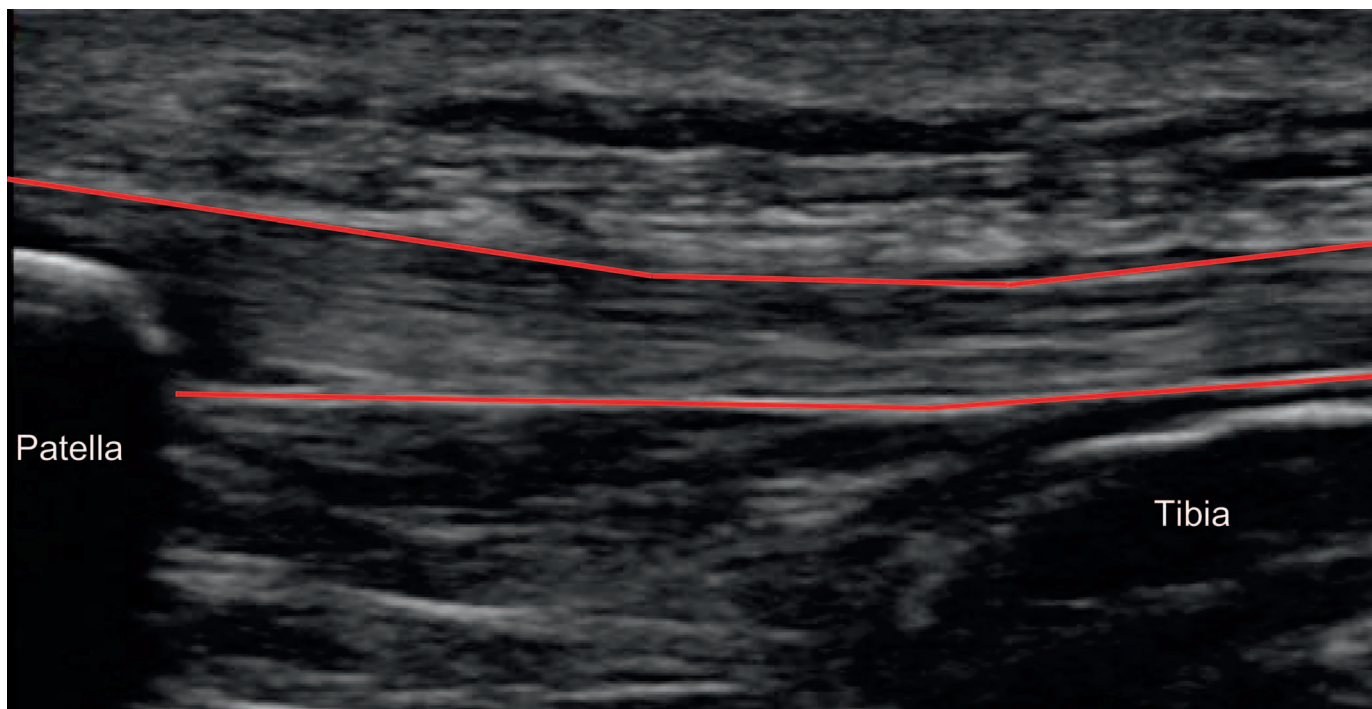


Figure 1. Patellar tendon outlined on ultrasound image.

tendinopathy can be differentiated from patellar tendon pain with palpation and tissue loading during resisted knee extension and functional activities; however, patellar tendinopathy and patellofemoral pain can coexist. Other differential diagnoses are fat-pad impingement syndrome, meniscal injury, cartilage degeneration, and bony abnormalities such as Osgood-Schlatter syndrome.³⁰

IMAGING

Clinical assessment is the most appropriate means and criterion standard for diagnosing patellar tendinopathy. However, imaging may be used for confirmation and to assess other conditions that may coexist with patellar tendinopathy.³⁰ Plain film radiographs, diagnostic ultrasound, and magnetic resonance imaging (MRI) can help assess the integrity of the patellar tendon and surrounding structures. Radiographs are typically the initial imaging modality for evaluating the bony structures of the knee, including enthesophytes, which can develop on the inferior pole of the patella. Conditions such as Osgood-Schlatter and intratendinous calcifications may also be investigated using plain radiographs.¹⁵

Diagnostic ultrasound (Figure 1) is 83% accurate in correctly identifying patellar tendinopathy with moderately high sensitivity (87%) and specificity (82%; positive likelihood ratio = 4.8, negative likelihood ratio = 0.2).³⁰ The patellar tendon may show thickening and a greater cross-sectional area than normal.^{31,32} On average, the thickness and width of a healthy tendon range from 3 to 6 and 10 to 15 mm, respectively.¹⁵ Hypoechoic changes within the patellar tendon are pervasive in asymptomatic athletic populations, particularly as competition levels increase.³³ Further, patellar tendon abnormality was more prevalent in male than in female athletes.³³ These abnormal

tendon changes result in a 5 times greater risk for tendinopathy compared with normal tendons.³³ *SOR: A*

On MRI, increased T2 signal intensity within the patellar tendon corresponds with degenerative changes (Figure 2).³⁴ Tendon thickening may also be prevalent on MRI.³⁴ In more severe cases, calcification within the tendon may be present, portrayed as well-defined areas of low signal.¹⁵ Unlike diagnostic ultrasound, the accuracy of MRI in diagnosing patellar tendinopathy is only 70%, with a similar specificity (82%) as ultrasound but worse sensitivity (57%), positive likelihood ratio (3.1), and negative likelihood ratio (0.5).³⁰ *SOR: A*

PATIENT-REPORTED OUTCOME MEASURES

The International Scientific Tendinopathy Symposium Consensus³⁵ recently identified 9 core domains for tendinopathy to guide clinical research trials that can also provide a comprehensive road map for clinicians in their evaluation process (Table 1). Several disease-specific patient-reported outcomes for assessing patellar tendinopathy cover a significant portion of these domains, including symptom severity. The most widely used patient-reported outcome measure is the Victorian Institute of Sport Assessment–Patella (VISA-P).³⁶ The VISA-P is scored with a maximum of 100 points; higher scores indicate better function, and the minimally clinically important difference is 13 points.³⁷ A cutoff score of <80 is frequently used to characterize patellar tendinopathy and as an inclusion criterion for research. The VISA-P alone can differentiate individuals with and those without patellar tendinopathy as well as identify improvements from therapeutic interventions among patients with patellar tendinopathy.³⁸ The Oslo Sports Trauma Research Center–Patellar Tendinopathy (OSTRC-P) outcome measure was developed and studied among youth basketball players.³⁹ The OSTRC-P is a 10-

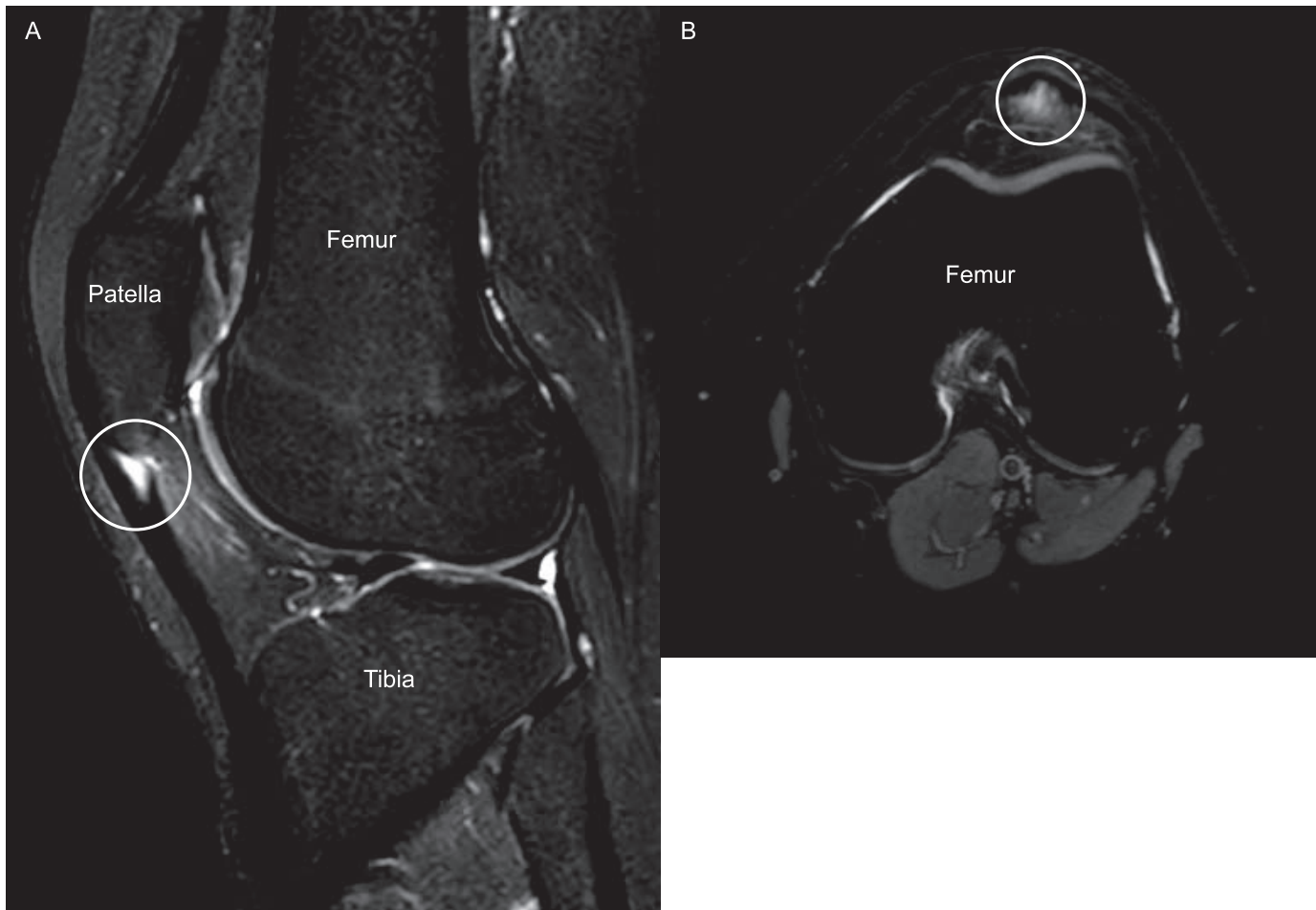


Figure 2. A, Sagittal and, B, axial views of a T2-weighted magnetic resonance imaging scan of a patient with symptomatic patellar tendinopathy. Circles highlight focal regions of tendinopathy, which present as increased (white) signal in the substance of the tendon.

item questionnaire scored with a maximum of 100 points that is used to identify patellar tendinopathy and its severity. Higher values indicate increased severity.³⁹ The OSTRC-P has demonstrated good sensitivity (79%) and excellent specificity (95%) compared with the clinical assessment of patellar tendinopathy.³⁹ Visual analog scales are also used frequently and were reliable and sensitive tools in the evaluation of pain in patients with patellar tendinopathy.⁴⁰ *SOR: A*

CLINICAL MANAGEMENT

Patellar tendinopathy rehabilitation can be a lengthy, arduous process for patients and clinicians, as the condition

often persists for months, if not years.¹² Therefore, using the International Classification of Function model can provide an organized, patient-centered approach to caring for individuals with patellar tendinopathy (Figure 3).⁴¹ Conservative treatment is recommended. Surgical treatments should be considered only for those with advanced symptoms and reduced function and quality of life and after conservative treatment has failed.²⁸ Consistent with treatment approaches to Achilles tendinopathy,⁴² rehabilitation for patellar tendinopathy can be segmented into 4 phases: symptom management and load reduction, recovery, rebuilding, and return to unrestricted sport participation (Table 2). Specific progressions depend on severity, compliance, pain, and duration of symptoms. Conservative

Table 1. Core Domains for Tendinopathy Assessment (International Scientific Tendinopathy Symposium Consensus 2019)³⁵ and Specific Examples Pertaining to Patellar Tendinopathy

Core Domain for Tendinopathy	Patellar Tendinopathy–Specific Example
Patient rating of condition	Global rating from 0% to 100% of the patient's feeling about patellar tendinopathy status
Activity participation	Tegner Activity Scale, Activities of Daily Living Scale
Pain during activity, loading, or both	100-mm Visual analog scale immediately after single-legged squat on the affected limb(s)
Patient function	Lower Extremity Functional Scale, Lysholm Knee Scale
Psychological factors	Tampa Scale of Kinesiophobia, Pain Catastrophizing Scale
Physical function capacity	Quadriceps strength, quadriceps flexibility, single-limb hop for distance, 6-m hop test
Disability	Victorian Institute of Sport Assessment–Patella or Oslo Sports Trauma Research Center–Patellar Tendinopathy
Health-related quality of life	Short Form Survey-36
Pain over a specific time	100-mm Visual analog scale for pain

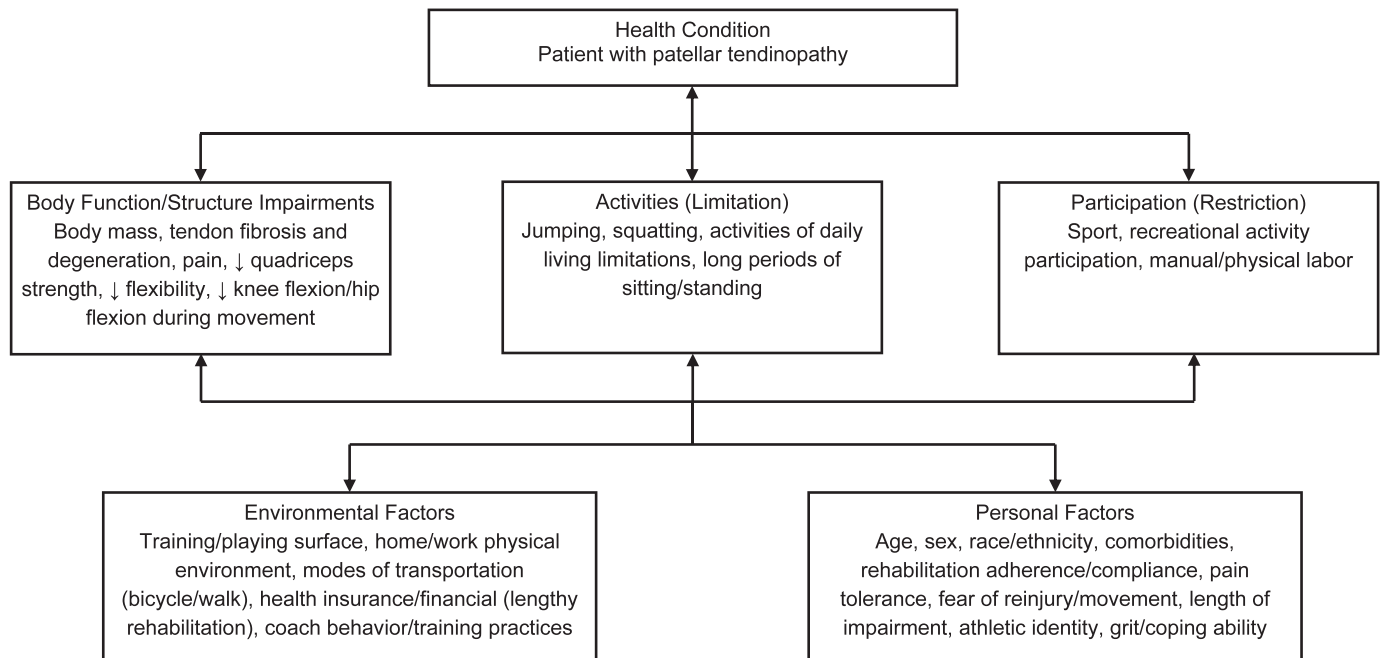


Figure 3. An example using the International Classification of Function model for patients with patellar tendinopathy, which can also be individualized.

management is multifaceted and can include activity modification, exercise rehabilitation, and therapeutic modalities.⁴³

Load-Management Strategies

For improving patellar tendinopathy-related symptoms and function, rest and passive modalities are inferior to exercise and progressive loading regimens.⁴³ Thus, modifications and optimization of training loads throughout the recovery process are paramount to initially reduce patellar tendon stress, followed by progressive increases to improve tendon health.⁴⁴ Load-management programs that involve reducing the volume and frequency of sporting or other exacerbating activities have been used successfully to manage initial symptoms and pain.⁴⁵ Appropriate load management can be monitored and progressed using a pain-monitoring model. Pain-monitoring models most commonly rely on visual analog scales. The pain-monitoring model described by Silbernagel et al⁴⁴ for patients with Achilles tendinopathy may be broadened for use with all tendinopathies: 5 points out of 10 on a numeric pain-rating scale is considered the threshold for allowable pain. Reaching a score of 5 during and after the exercise protocol is acceptable, but the tendon pain must be <5 the following day. If a patient reports an increased level of pain from week to week, the activity should be reduced.

A collaborative approach involving the sports medicine clinicians, strength and conditioning staff, and coaching staff is necessary to achieve appropriate load management. This also requires patient education and involvement in the decision-making processes (“buy in”) to ensure the greatest opportunity for success using conservative management techniques. Incorporating these professionals and the patient into the discussion of activity modification allows the athlete to continue to train or practice with limitations while minimizing the loss of skill development. For

example, blocking drills in volleyball often use shuffle steps with maximum vertical jump blocking and a coordination of front-row players to “double block.” In the symptom-management and load-reduction phase, this drill could be modified by eliminating the vertical jump, which allows the athlete and his or her teammates to continue participating and maintaining their court awareness while reducing the load on the athlete’s patellar tendon. In the recovery phase, this activity can be progressed by allowing submaximal jumping and touching only the top of the net. Later in the rebuilding phase, the vertical jumping component can be progressively increased to reintegrate the athlete into unrestricted sport participation.

Exercise Protocols

Exercise regimens consisting of progressive tendon loading have demonstrated the most consistent evidence for treating and providing long-term improvements in individuals with patellar tendinopathy.⁴³ Tensile stresses are created within the patellar tendon during quadriceps-muscle contraction. Therefore, patellar tendon-loading exercise programs should be centered on quadriceps-strengthening exercises. Quadriceps-strengthening exercises can be effectively progressed using various methods that include increases in velocity, load, or volume.⁴⁶ This allows the clinician to customize eccentric programs for specific athletes or sport positions. For example, an endurance athlete may benefit from progressions with increases in exercise volume, whereas an athlete who relies more on power may benefit from increases in velocity or load.

Eccentric quadriceps-strengthening programs have been the most studied and were shown to be effective in improving long-term pain and patient-reported outcomes. For any quadriceps-strengthening program, the pain-monitoring model can again be used to progress training

Table 2. Patellar Tendinopathy Management Strategies^a

Phase	Symptom Management and Load Reduction		Recovery	Rebuilding	Return to Unrestricted Sport Participation
	Wk 0–4	Wk 2–6			
Time					
Load management					
Visual analog scale score	<5 cm	<5 cm		<3 cm	<1 cm
Sport participation and volume	<25%	<50%		<75%	100%
Goal	Understand condition, training loads, and pain tolerance to ↓ stress on patellar tendon	Gradually ↑ physical activity and introduce progressive loading programs		Continue to ↑ patient load capacity during physical activity and exercise program	Symptoms should be minimal to none during physical activity and progressive-loading phases
Activity modification	Replace jumping, squatting, etc, with cycling or aquatic therapy	Begin integrating submaximal jumping and squatting into exercise regimen		Begin introducing maximum jumping and moderate plyometric training	No restrictions
Exercise paradigm and progression	Complete exercises daily	Complete exercises daily		Exercises 3–5×/wk	Exercises 2–3×/wk
	Isometric quadriceps activation (“quad sets”) sitting on table in full knee extension: 5 reps, ↑ time from 30 to 60 s each	Concentric double-legged knee extensions: 3 × 10 at tolerable weight, ↑ to 3 × 15, guided by pain-monitoring models as tolerated		25° Single-legged decline squats: approximately 30-s count with progressive load ↑	25° Single-legged decline squats: approximately 30-s count with progressive load ↑
	Isometric quadriceps contractions with leg-extension machine: 5 reps, ↑ time from 30 to 60 s each	25° Double-legged decline squats: approximately 30-s count; monitor tolerance and progress to single-limb loads guided by pain-monitoring models as tolerated		Squat: 4 sets × 15 RM	Squat: 4 sets × 6 RM
	Spanish squat: 5 reps, ↑ time from 30 to 60 s each			Leg press: 4 sets × 15 RM	Leg press: 4 sets × 6 RM
				Hack squat: 4 sets × 15 RM	Hack squat: 4 sets × 6 RM
				Progress patients to 6 RM using the pain-monitoring models as tolerated.	Progress to greater loads as strength capacity ↑
Adjuvant therapy	Quadriceps-stretching exercises	Quadriceps-stretching exercises		Quadriceps-stretching exercises	Quadriceps-stretching exercises
	Noxious transcutaneous electrical nerve stimulation	Patellar tendon strapping during activity		Patellar tendon strapping during activity	
	Low-powered laser therapy or iontophoresis				

Abbreviations: rep, repetition; RM, repetition maximum.

^a Exercises, timing, and load-management strategies are provided as an example and may require individualization based on the patient's symptoms, function, and goals.



Figure 4. The 25° decline squat.

loads adequately and appropriately. For eccentric protocols, the most common and effective programs include decline squats completed at a slow speed on a 25° slant board (Figure 4).⁴⁷ Static stretching of the quadriceps combined with eccentric quadriceps strengthening may provide greater benefits than strengthening alone.⁴⁸ Dimitrios et al⁴⁸ had participants perform static stretching of the quadriceps and hamstrings muscles before and after strengthening exercises. The group that performed stretching combined with eccentric training demonstrated better outcomes at the end of treatment and at the 6-month follow-up than the eccentric-only group.⁴⁸ *SOR: A*

Protocols that progressively load the tendon through other methods of slow, heavy resistance exercises, such as concentric and isometric quadriceps-muscle contractions, may be less painful than eccentric quadriceps strengthening and can also result in long-term pain reduction and tendon healing. Recently, Breda et al⁴⁹ reported that a progressive technique using a 3-stage approach of isometric, isotonic, and sport-specific loading in patients with patellar tendinopathy led to better subjective functional outcomes compared with eccentric loading alone. However, ultrasound imaging revealed no differences in markers of tendon healing. Kongsgaard et al³⁸ observed that a heavy, slow, concentric and eccentric resistive-exercise protocol demonstrated better tendon morphologic changes and subjective function than eccentric exercises alone. The slow, heavy,

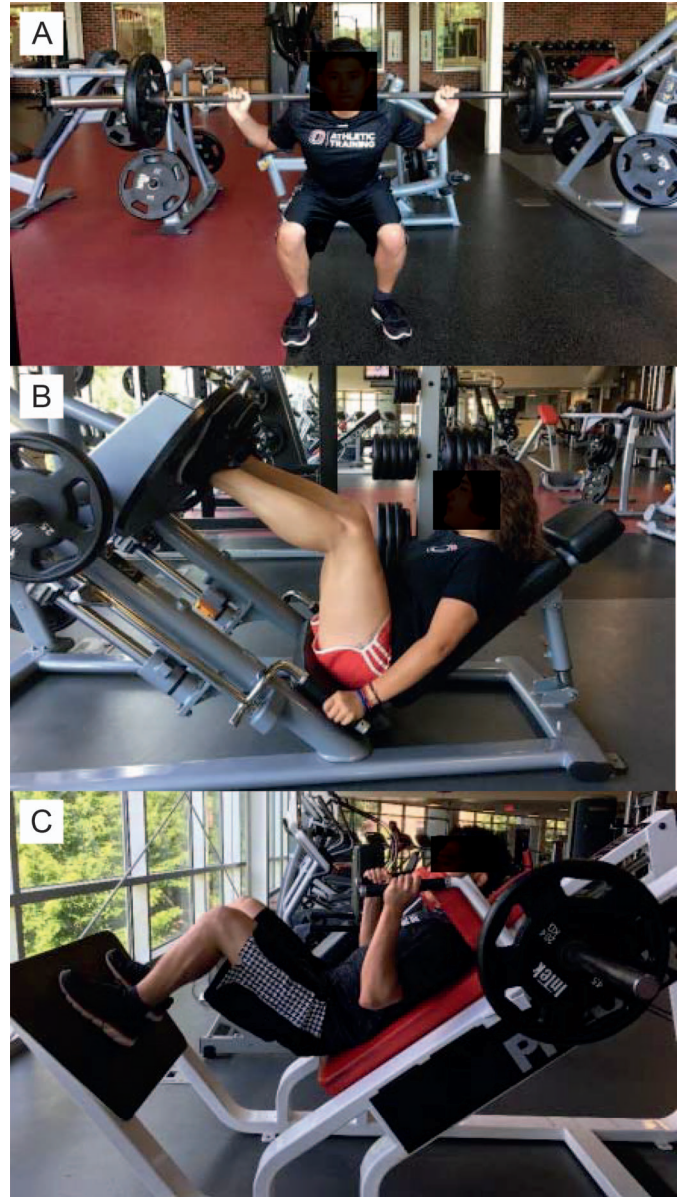


Figure 5. A, Squat, B, leg press, and, C, hack squat.

concentric and eccentric resistive-exercise protocol³⁸ used a progressive increase in load during the squat, leg press, and hack squat (Figure 5), each completed with 4 sets of 6-second repetitions (3 seconds concentric, 3 seconds eccentric). Their weekly progression began with a 15-repetition maximum (RM) during the first week, followed by a 12-RM during the second and third weeks, a 10-RM in weeks 4 and 5, an 8-RM in weeks 6 through 8, and finally a 6-RM in weeks 9 to 12.³⁸ *SOR: A*

Although progressive loading through slow, heavy quadriceps-resistance exercises has produced long-term effectiveness, in-season sport quadriceps isometric protocols may provide short-term pain relief to limit time loss during the season. Isometric exercises may improve adherence during the season, offering an alternative to more painful treatments such as eccentric or heavy, slow resistance exercises.⁵⁰ In 1 study,⁵¹ a technique known as the *Spanish* or *Catalan squat* was used with a rigid belt or exercise band, and patients completed 5 repetitions of 30



Figure 6. Spanish or Catalan squat using an exercise band.

seconds each (Figure 6). An alternate isometric exercise protocol used a leg-extension machine with the knee at 60° of flexion and 5 repetitions of 45 seconds each.⁵² These isometric protocols resulted in significant short-term pain relief for patients with patellar tendinopathy. *SOR: B*

Supportive Treatments

Therapeutic interventions and injection therapies beyond exercise regimens may offer symptomatic relief but typically only short-term benefits for tendon health. Several modalities that are standard in sports medicine clinics and are often used to treat tendinopathy have little evidence to support their use clinically. Contributing to the lack of clarity, research studies have often lacked a control or placebo group or frequently combined these adjuvant therapies with exercise regimens, muddling their efficacy as separate entities, or both.^{38,43,45,47,53,54} Therefore, we suggest supportive treatments be used only in combination with progressive quadriceps-strengthening and patellar tendon-loading programs.^{38,43,45,47,53,54} The 1 group⁵⁵ that assessed low-powered laser therapy plus eccentric training for treating patellar tendinopathy found improvements in the VISA-P and pain, but multiple randomized controlled trials⁴³ have demonstrated moderate effectiveness in reducing lateral elbow tendinopathy pain (*SOR: A*). Only single studies have been completed on iontophoresis and dry needling, and both produced short-term pain relief in

patients with patellar tendinopathy (*SOR: C*).⁵⁴ Neuromuscular stimulation in combination with quadriceps-muscle strengthening was assessed in 1 case series⁵³ of 6 patients with patellar tendinopathy and resulted in decreased pain (*SOR: C*). In addition, some evidence⁵⁶ suggests that localized noxious pain protocols as well as low- and high-frequency transcutaneous electrical nerve stimulation may relieve short-term pain in patients with lateral elbow tendinopathy, but again, this has not been studied in populations with patellar tendinopathy. Compared with placebo treatments, nonthermal ultrasound showed no differences and offered no therapeutic benefits to patients.⁴⁷ *SOR: A*

Taping and strapping have been used to provide relief during sport activities. Patellar tendon strapping provided an approximately 25% reduction in pain with immediate application.⁵⁷ Only 1 set of authors⁵⁸ has evaluated Kinesio Taping as a potential therapy for patellar tendinopathy: they noted a small to moderate pain decrease versus sham taping. Neither of these techniques has demonstrated long-term benefits or an effect on tendon properties. *SOR: B*

Another treatment often used to manage patellar tendinopathy is injection-based treatments such as corticosteroids and platelet-rich plasma (PRP) therapy. Although corticosteroid injections displayed good short-term (approximately 1 week) pain relief, they provided little long-term benefit and are potentially harmful via joint, cartilage, and tendon degeneration and, thus, should be avoided (*SOR: A*).^{38,59} Platelet-rich plasma has been suggested as a viable treatment to assist in patellar tendinopathy recovery; however, the quality of research on its use is lacking (*SOR: B*).⁴³ Leukocyte-rich PRP shows more promise than its leukocyte-poor counterpart.⁶⁰ Furthermore, investigators⁶¹ in 1 study found that approximately 80% of participants returned to their previous sporting activities after PRP treatments; results were poorer in patients who had a longer history of symptoms. As such, leukocyte-rich PRP may be a viable option in patients who have failed to improve on other forms of conservative therapy. If PRP is determined to be appropriate, the injections should be performed under ultrasound guidance to identify the exact location of the tendinopathy.⁵⁹

Surgical Interventions

In the most severe and chronic cases of advanced patellar tendinopathy, surgical intervention may be warranted. Surgery is typically not considered unless extensive conservative management for >6 months has failed to relieve symptoms.⁴ Although arthroscopic procedures have been described, open debridement with or without repair remains a reliable procedure.⁴ Surgical techniques involve identification of the macroscopically abnormal tissue (see Supplemental Figure, available online at <https://doi.org/10.4085/1062-6050-0049.21.S1>) with excision back to normal-appearing tissue borders.⁴ Depending on the volume of tissue involved and surgeon preference, subsequent repair of the tendon back to the patella can be undertaken. In 1 study⁴ of open procedures, patients had symptoms for an average of 3.8 years, had ceased sporting activities for approximately 7 months, and returned to participation between 7 and 12 months postoperatively. However, the outcomes of surgical interventions have been mixed. The

authors⁶² of a recent systematic review concluded that surgery was no better than sham surgery in improving pain, function, or range of motion among patients with patellar tendinopathy. *SOR: A*

SUMMARY

Patellar tendinopathy is a complex condition that requires a multidisciplinary and multifaceted approach to ensure patient recovery. Understanding its pathophysiology and performing a comprehensive assessment will guide the clinician through treatment. Load-management strategies combined with tendon-loading exercise protocols are the most consistent and effective treatments for improving long-term outcomes in patients with patellar tendinopathy. Traditional modalities are supportive and may assist in pain relief, whereas more complex, persistent cases may require surgical intervention. Regardless of the treatment, patellar tendinopathy requires a lengthy course of appropriate rehabilitation and vigilance by both the patient and clinician.

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SUPPLEMENTAL MATERIAL

Supplemental Figure.

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