The Use of Eccentric Overloading Exercise for the Treatment of Patellar Tendinosis in an Olympic-style Weightlifter: A Case Report

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ABSTRACT

Study Design: Case report. **Background and Purpose:** The purpose of this case report is to describe the conservative management of patellar tendinosis in a college-aged Olympic-style weightlifter using a rehabilitation protocol focusing on eccentric overloading of the affected patellar tendon. **Case Description:** An 18-year-old male, competitive Olympic-style weightlifter presented to the clinic with complaints of aching pain at the proximal insertion of the right patellar tendon into the inferior patella limiting his ability to perform knee-flexing activities and his ability to perform his sport for the previous 2.5 months. A diagnosis of patellar tendinosis was supported by the physical examination and subjective history. The patient's quadriceps strength, knee range of motion (ROM), and reported pain were monitored over time. The patient's functional progress was monitored throughout the patient's rehab using 4 reliable and validated self-report questionnaires. **Intervention:** Treatment consisted of independent stretching of the quadriceps, resistive strengthening of the gluteus medius and quadriceps, eccentric overloading of the quadriceps and patellar tendon, and proprioceptive/balance activities for the knee complex. As the primary focus for strengthening, a progressive eccentric overload exercise program was used in order to promote collagen synthesis and regeneration of the degenerative tendon. **Outcomes:** The patient had improvements in reported pain, knee flexion ROM, and quadriceps strength of the affected knee. Improvements were also seen in all functional questionnaires from initial evaluation to discharge. **Discussion:** Currently, there is no preferred treatment for patellar tendinosis. Eccentric exercise training has been described with successful results in the treatment of this condition both in the literature and with this patient, but no optimal protocol has been described.

Key Words: patellar tendinosis, weightlifter, eccentric overload

INTRODUCTION

Patellar tendinopathy, also known as "Jumper's Knee," is a common pathology affecting athletes at all levels across many sports.[1] Those participating in jumping sports such as volleyball and basketball are most often affected.[1-3] Patellar tendinopathy, however, has also been known to affect nonjumping athletes in which high leg extensor speed, power, and eccentric demands are placed on the knee extensor mechanism, such as those participating in Olympic-style weightlifting.[1-3]

Olympic-style weightlifting requires the athlete to perform controlled, high force movements at the knee. It has been estimated that forces 17 times the weightlifter's body weight are acting through the patellar tendon during heavy-weighted lifts such as the "snatch" and "clean and jerk."[4] During these lifts, the athlete's knees quickly and repeatedly go through the full range of motion (ROM) at high speeds, and the patellar tendon must control the motion concentrically and eccentrically. During a 6-year study performed at the US Olympic Training Centers at Colorado Springs and Lake Placid, the knee was the second most commonly injured site (n= 107) of the 560 training related injuries occurring in Olympic-style weightlifters. Of those 107 knee injuries, 85.1% of them were designated as knee tendinitis.[5]

There is much confusion in the literature and within the clinical setting regarding the terminology of tendon conditions. "Tendinopathy" is a broad term referring to a tendon injury without specifying a particular pathology. Tendinopathy can then be subdivided into tendinitis and tendinosis with the difference being the underlying pathology. "Tendinitis" implies an acute inflammatory process is taking place while "tendinosis" refers to a chronic degeneration of a tendon due to failed healing without an inflammatory process present.[4] While imaging and histologic studies are the gold standard in the diagnosis of these two conditions, a clinical history and examination may be helpful in determining one diagnosis over the other.[6] Tendinitis is considered a rare, acute condition and is likely to be reported by the patient as responding to anti-inflammatory treatments.[2,7] Tendinosis, however, is a much more common and chronic condition. The patient suffering from tendinosis is likely to report this as a long-term issue that has not responded well to anti-inflammatory interventions.[2,7] It is this confusion in terminology and difficulty with diagnosis that may interfere with optimal treatment since the focus in treating tendinitis would be on decreasing inflammation while the treatment of tendinosis would be on promoting collagen synthesis and strengthening.[7]

Once a tendinosis diagnosis has been established, the treatment focus becomes stimulation of collagen synthesis in order to reverse the degeneration of the tendon. While many conservative management options exist for patellar tendinosis, many lack the evidence to support their use, especially in collagen synthesis.[2,6] Exercise in general has been shown to increase collagen synthesis in peritendinous connective tissue.[8] Recent literature has demonstrated promising results in the treatment of tendinopathy using eccentric exercise.[2-4,7,9-11] A 2007 study by Langberg et al[11] demonstrated that a 12-week program of eccentric exercise may be associated with increased rates of collagen synthesis in subjects with Achilles tendinosis. Recent studies have been able to demonstrate the advantages of eccentric exercises in treating patellar tendinosis versus surgical treatment and other types of conservative management. Bahr et al[3] supported the use of eccentric training as a "low-risk and low-cost" alternative to open tenotomy surgery in the treatment of patellar tendinosis since no advantage was demonstrated in surgical subjects over the eccentric training subjects participating in the study. Additionally, Alfredson and colleagues[9,10] published 2 articles supporting the use of eccentric exercises in the treatment of patellar tendinosis. While there is literature to support the use of eccentric exercises in treating patellar tendinosis, the underlying mechanisms for its benefits are debated. Several theories have been proposed to explain these benefits including: (1) eccentric exercises generate a loading-induced hypertrophy that produces collagen and increases tensile strength of the tendon, (2) eccentric exercises produce a stretching effect lengthening the muscle-tendon unit and reducing strain on the tendon, and (3) eccentric exercises damage the neovascularization found in degenerative tendons that may be responsible for the patient's pain.[4,6,11]

With encouraging results found in the literature, the use of eccentric training has gained support in the treatment of patellar tendinosis. Despite the lack of evidence for an optimal protocol in the prescription of eccentric exercise interventions, researchers continue to suggest varying treatment programs producing positive results. The purpose of this case report is to describe the conservative management of patellar tendinosis in a college-aged Olympic-style weightlifter using a rehabilitation protocol focusing on eccentric overloading of the affected patellar tendon.

CASE DESCRIPTION

History

The patient was an 18-year-old male, competitive, Olympic-style weightlifter who presented to our outpatient physical therapy clinic with complaints of aching pain at the proximal insertion of the right patellar tendon into the inferior patella. The patient was experiencing these symptoms for the previous 2.5 months following a sudden onset of excruciating knee pain while performing a jerk during competition. During those 2.5 months, the patient abstained from weightlifting activities that required motion at the knee and began taking nonsteroidal anti-inflammatory drugs (NSAIDs) and using cryotherapy for pain and inflammation. The patient decided to see his physician and was then referred to physical therapy when his symptoms failed to improve despite rest and anti-inflammatory interventions. The patient reported that the radiographs taken were negative. The patient denied any prior physical therapy for the current condition.

At the time of initial evaluation, the patient's subjective report revealed that his condition was aggravated by ascending/descending stairs, squatting/kneeling, and performing weightlifting maneuvers, and was temporarily eased by rest. A visual analog scale (VAS) was used to measure the patient's reported levels of patellar tendon pain at the initial evaluation and the start and completion of each treatment session. The VAS is a reliable (r = 0.97) 11-point Likert Scale ranging from 0 to 10 in which 0 is no pain and 10 is the patient's worst pain imaginable.[12] At best and at the time of evaluation, the patient's patellar tendon pain was a 3/10, and at worst, an 8/10. The patient also reported that his pain had increased in intensity and frequency since the time of his initial injury.

The patient reported a past medical history of bilateral knee pain secondary to abnormal lateral tracking of the patella. He stated that this occurred 2.5 years ago and that he was prescribed patella tracking braces and physical therapy but chose to forgo physical therapy since the braces were relieving his pain. The patient reported he was wearing both braces at the time of his current injury.

Patient Examination

Upon examination, the patient ambulated independently without significant gait abnormalities. A standing postural screen revealed no significant findings and leg length screenings were unremarkable. Physical examination of the knee indicated patellar crepitus, bilaterally, right greater than left, with normal tracking of the patella during active knee extension from 90° to 0° of flexion. However, a patellofemoral compression test, also known as the McConnell Test,[13] was negative, bilaterally. Patellofemoral joint mobility testing in all planes did not reveal any limitations, bilaterally.

Range of motion measurements of the knee were 10°/0°/140° and 10°/0°/145° for the right and left, respectively using standard landmarks as outlined by Norkin and White.[14] The literature indicates that goniometric measurements of the knee joint are both reliable (r = .98) and valid (r = .97-.98).[15] Manual muscle testing (MMT) of the hamstrings, gluteus medius, and quadriceps were tested in standard positions.[16] The strength of the hamstrings were a 5/5 bilaterally; gluteus medius strength was 5/5 on the right and 4+/5 on the left; quadriceps strength was 4+/5 on the right with pain during manual loading, and 5/5 on the left. Florence et al found that MMT is reliable in measuring knee strength (r = .93).[17] Lower extremity flexibility was measured using positions outlined by Dutton[13] for hamstring, iliotibial band, quad, hip flexor, and soleus length. Using a prone knee flexion test,[13] only a minimal limitation was found in the flexibility of the right quadriceps as exhibited by the patient's inability to touch his right heel to his buttocks.

Upon observation of the bilateral knees, there was no visible redness, increased heat, or swelling. Palpation of the right knee revealed tenderness at the proximal insertion of the patellar tendon. Cook and colleagues[18] has found moderate to severe tenderness during palpation of the proximal third of the patellar tendon and its insertion into the patella to be a predictor of patellar tendinopathy in young athletes. The patient's patellar tendon pain was further exacerbated in performing a quad set. Additional testing included unsupported bilateral and single leg squat tests.[13] During both squat tests, the patient experienced painful popping and clicking in the right knee with deep knee flexion and during the ascending portion of the squat.

In addition to the tests performed during the examination that would be used to monitor the patient's impairment outcomes, the patient was asked to fill out a number of surveys that would be used to monitor his self-reported functional progress throughout treatment. The following functional outcome surveys were used: The Lower Extremity Functional Scale (LEFS), The Cincinnati Knee Rating System (Cincinnati), The International Knee Documentation Committee Subjective Knee Form (IKDC), and the Victorian Institute of Sport Assessment (VISA). The LEFS was used to evaluate general lower extremity physical function. Both the Cincinnati and IKDC more specifically focused on the knee, with the Cincinnati monitoring knee impairments and function, and the IKDC monitoring function in sport in addition to function during activities of daily living. The VISA, specifically designed to monitor patellar tendinopathy, tested similar constructs to those found in the other questionnaires but was used in this case because it contains items focusing on the amount of time the patient is able to participate in sporting activities based on 3 categories. These 3 categories ranged in severity from "pain that stops you from completing sport activities," to "pain while undertaking sport activities but it does not stop you," and, finally "no pain while undertaking sport activities." The patient would be questioned on the amount of time he was able to participate in sports based on the category he fell into at that point in his rehabilitation and his score would be weighted according to the level of function reported. All of the stated tests were found to be reliable, valid, and responsive to change in evaluating their given patient population as seen in Table 1.

Table 1. Overview of Functional Outcome Measure Questionnaires

	Construct	Reliability	Validity	Standard Error of Measure
Lower Extremity Functional Scale[19]	Lower extremity physical function	α=.96 R=.86	r = .80	3.9
Cincinnati knee-rating system[20]	Knee impairment and physical function	R= .88	r =.68	10
International Knee Documentation Committee Subjective Knee Form[21]	Knee-specific symptoms, function and sports activity	α=.92 R=.95	r = .47 -.66	9
Victorian Institute of Sport Assessment Scale[22]	Severity of Patellar Tendinosis	R=.95	Not found in literature	3

Patient Evaluation

Examination revealed ROM, strength, and flexibility impairments in the right knee compared to the left knee and tenderness to palpation of the patellar tendon at its attachment into the patella. In evaluating these findings, the following differential diagnoses were considered: patellofemoral pain syndrome (PFPS), patellar tendinitis, and patellar tendinosis. Patellofemoral pain syndrome was the first consideration as the patient complained of many of the symptoms consistent with this diagnosis including aching anterior knee pain, retropatellar pain, and pain with knee-flexing activities such as squatting and stair ascending/descending. The patient also had reported a history of lateral tracking of the patella in each limb, which is another finding consistent with PFPS. Although the examination revealed normal tracking of the patella and a negative patellofemoral compression test, PFPS could not be ruled out as a diagnosis based on the patient's reported symptoms. Regardless of this finding, this does not address the patient's primary complaint of point tenderness directly over the patellar tendon, which is a common symptom of a patellar tendinopathy.[2] In instituting a plan of care for this patient, it would be helpful to establish the underlying pathology of this tendinopathy. Based on the patient's history of a poor response to anti-inflammatory interventions such as NSAIDs and ice, the patient's 2.5 month time from injury, and the lack of localized swelling and erythema evident during examination, it was hypothesized that the patient was likely suffering from a necrotic, rather than inflammatory, condition. Patellar tendinitis is defined as an acute inflammation of the patellar tendon;[4] therefore, this diagnosis was eliminated from consideration. Patellar tendinosis, however, is a chronic degeneration of the patellar tendon without a present inflammatory process, and consequently, it was established that the patient presented with signs and symptoms consistent with patellar tendinosis. Intervention was directed toward treatment of the pathology and impairments associated with this diagnosis.

Intervention

The patient was seen for 11 visits (including the initial evaluation) over a span of 6 weeks. During that time, treatment was focused on addressing those functional deficits and impairments found during the initial evaluation. Treatment addressed ROM, strength, flexibility, and functional limitations through a progressive program of independent stretching of the quadriceps, resistive strengthening of the gluteus medius and quadriceps, eccentric overloading of the quadriceps and patellar tendon, and proprioceptive/balance activities for the knee complex. The specific interventions used each visit are outlined in Table 2.

The primary focus of the strength training component of the patient's treatment was eccentric overloading of the quadriceps and patellar tendon. The supine shuttle, step downs, heel taps, leg press, and mini-squats were prescribed with emphasis on overloading the eccentric phase of the exercise in order to improve tensile strength and promote tendon regeneration. These exercises were initially prescribed in order to improve the patient's mechanics and eccentric control at the knee. The patient was asked to focus on keeping his right knee pointing in the same direction as his toes during all exercises in order to reduce the rotary forces on the knee. He was also told to not allow his knee to extend beyond his toes during shuttle and squats in order to reduce torque forces acting on the knee. Both of these motions increase torque forces and rotary stresses acting on the knee and increase the likelihood of injury.[23,24] The knee extension machine was used in a more focused effort to strengthen the right quadriceps. During all leg presses, mini-squats, and knee extension exercises, the patient was instructed to perform the eccentric quadriceps phase with his right lower extremity only and to use both lower extremities during the concentric quadriceps phase. In all resistance exercises completed by the patient, the weight initially lifted by the patient was 70% of a one repetition maximum for his right lower extremity and was then progressed over time to 100% of a one repetition maximum.

As the patient was able to competently perform the exercises with proper biomechanical technique and reduced pain, the focus of the squat exercises changed to increasing strength of the quadriceps and increasing the load through the patellar tendon in order to improve tensile strength and encourage collagen synthesis. At visit 5, the patient began performing squats on a 25° decline. The purpose of the 25° decline was to increase the demands on the knee extensor mechanism by relaxing the gastrocsoleus muscle complex.[9,10] Initially the patient performed the decline squat without additional weight and facing a wall in order to use the wall for balance as necessary. During the squat, the patient stood on the decline board with his full weight on the right lower extremity. He was instructed to keep the trunk as vertical as possible in order to minimize activity of the gluteal muscles[9] and slowly flex the right knee to 70° in order to guarantee that his knee was beyond the 60° position, the joint angle considered

Table 2. Treatment Intervention Flow Sheet for Each Patient Visit

	1: IE	2	3	4	5	6	7	8	9	10	11
Bike warm-up		10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min
Cross Friction Massage to the patellar tendon	10 min	5 min	5 min	5 min	5 min	5 min					
Prone Knee Flexion Stretch	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec	2 x 30 sec
*Mini-squats		ball squat 3x15	ball squat 3x15, 25 lbs	ball squat 4x10, 25 lbs	25° decline board 3x15	25° decline board 2x15; Smith machine with decline board 1x15, 50 lbs	Smith machine with 25° decline board 4x15, 70 lbs	Smith machine with 25° decline board 4x10, 80 lbs	Smith machine with 25° decline board 3x10, 90 lbs	Smith machine with 25° decline board 3x10, 90 lbs	Smith machine with 25° decline board 3x10, 110 lbs
Step Downs (SD) & Heel Taps (HT)		SD: 8" step x40	SD: 8" step x40	SD: 8" step x40; HT: 8" step x30	SD: 8" step x50; HT: 8" step x40	SD: 10" step x30; HT: 8" step x50	SD: 10" step x30; HT: 8" step x50				
Supine Shuttle			4 bands x50	4.5 bands x50	6 bands x75	8 bands x50					
*Knee Extension Machine				3x10, 60 lbs	3x10, 60 lbs	3x10, 60 lbs	3x10, 70 lbs	4x10, 80 lbs	3x10, 90 lbs		
Hamstring Curl Machine							3x10, 110 lbs	3x10, 110 lbs	4x10, 110 lbs		
Lateral Resistor with Thera-Band				Red, 4x20 yds	Red, 4x20 yds	Green, 2x20 yds	Green, 4x20 yds	Green, 4x20 yds	Blue, 4x20 yds	Blue, 6x20 yds	Black, 2x20 yds
Single Leg Stance						bosu ball with rebounder, x40	bosu ball with rebounder, x40	bosu ball with rebounder, x40	bosu ball with rebounder, x50	bosu ball with rebounder, x75	bosu ball with rebounder, x100
*Leg Press			5x10, 90 lbs	4x10, 95 lbs	4x10, 95 lbs	4x10, 95 lbs	4x10, 100 lbs	4x10, 110 lbs	4x10, 120 lbs		
Ice to Patellar Tendon		10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min		

*The patient performed the concentric quadriceps phase of the exercise utilizing both lower extremities and performed the eccentric quadriceps phase of the exercise using the right lower extremity only.

at which the maximum load is placed on the patellar tendon.[3] At this point, the patient was told to place his left foot on the decline board and use both lower extremities to complete the ascending portion of the squat in order to return to the starting position. The patient was told to work through what he considered to be "moderate" pain, and the exercise was progressed when there was no pain felt in the patellar tendon during the exercise.[9,10] As the patient was able to progress, the exercise was performed using the Smith machine in order to safely mimic some of the techniques used in Olympic-style weightlifting. Figure 1 depicts the decline squat being performed using the Smith machine.

In addition to the interventions listed in Table 2, the patient performed a twice daily home exercise program consisting of quadriceps stretches (2x30 sec) and ice as needed.

OUTCOMES

Over the course of the patient's 6-week rehabilitation program, reported pain on a VAS, knee ROM measurements, and quadriceps MMT were recorded for each of the 11 visits. In addition, the patient completed the LEFS, Cincinnati, IKDC, and VISA at initial evaluation, on visit 6 and on visit 11. These measurements and scores are shown in Table 3 and Table 4. By the third visit, the patient's right knee ROM had improved to that of the left knee and by visit 6, the patient was considered to have normal right quadriceps strength; while both improvements can be considered marginal, the patient's initial deficits were minimal. More importantly, the patient was reporting no patellar tendon pain by visit 4. Improvements were also seen from initial evaluation to visit 6 and visit 6 to visit 11 in the LEFS, Cincinnati, IKDC and VISA. As stated earlier in the text, the Standard Error of Measure (SEM) for the LEFS, Cincinnati, IKDC, and VISA are +3.9, 10, 9 and 3 points, respectively.[19-22] In considering the SEM for each of these functional scales, it is likely that changes in all 4 measures from initial evaluation to visit 6, as well as overall from initial evaluation to visit 11 can be considered improvements beyond measurement error. Additionally, changes from visit 6 to visit 11 in the LEFS, IKDC, and VISA may also be improvements beyond error. While there was a 10-point improvement in the Cincinnati from visit 6 to visit 11, this may or may not be a change due to error. Scoring improvements noted in the LEFS, IKDC, VISA, and Cincinnati were across many constructs of function. The largest increases in scores for all questionnaires were seen from initial evaluation to visit 6. Because many of the constructs measured by these questionnaires considered pain's effects on function, there may be an association between the patient's score improvements and the fact that he was no longer reporting patellar tendon pain by visit 6. The patient's largest score increases across the LEFS, Cincinnati, and IKDC questionnaires were seen in items pertaining to those activities the patient reported as his most painful at initial evaluation. These painful activities included squatting and stair ascending/descending. In addition the patient cited inability to perform higher functioning tasks such as, sport-related activities, and endurance activities secondary to pain and weakness. Furthermore, over time as the patient's pain improved and no longer affected his ability to perform sport-related activities, the VISA voided the largest score improvements in heavily weighted scoring items pertaining to pain and time spent on sports training.

The patient was discharged following visit 11 because of his decreased pain symptoms, increased flexibility and strength, improvement in function, and independence in performing the exercises comprising his rehab program. Furthermore, he successfully met his rehabilitation goals set out in his initial evaluation. He was provided with verbal and written instruction in a home exercise program (HEP) comprised of knee stretching and strengthening exercises. Because the patient had access to a gym, many of the exercises in his HEP were those he had performed during his rehab program.

Table 3. Impairment Outcome Measures

	Initial Evaluation	Visit 6	Discharge
Pain: pre-tx post-tx	8/10 3/10	0/10 0/10	0/10 0/10
ROM right knee	10/0/140°	10/0/145°	10/0/145°
Quadriceps MMT	4+/5	5/5	5/5

Table 4. Functional Questionnaire Outcome Measures

	Initial Evaluation	Visit 6	Discharge	Overall Change ‡
Lower Extremity Functional Scale	37/80	73/80	79/80	42*
Cincinnati Knee Rating System	36/100	82/100	92/100	56*
International Knee Documentation Committee Subjective Knee Evaluation	29.90%	73.60%	88.50%	58.6%*
Victorian Institute of Sport Assessment Scale	11/100	63/100	97/100	86*

‡ Overall score change from initial evaluation to discharge
***Change larger than SEM**

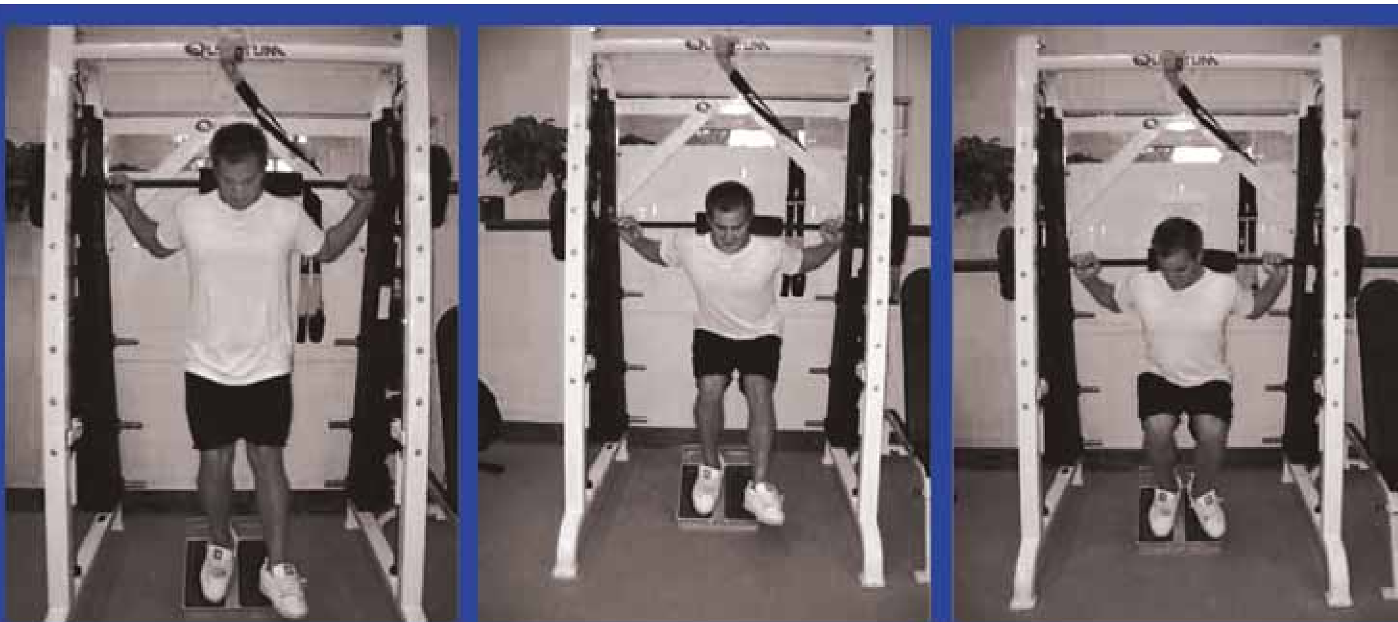
DISCUSSION

This case report describes the specific protocol used in the treatment of a competitive Olympic-style weightlifter presenting with signs and symptoms of patellar tendinosis. While the literature currently does not allude to a preferred treatment for patellar tendinosis, surgical treatment has not been demonstrated to be more effective than conservative treatment.[3] The patient in this case report was able to demonstrate improvements in right knee ROM, right quadriceps strength, reported patellar tendon pain, and overall knee function following a conservative rehabilitation program consisting of stretching and strengthening of the right quadriceps and a progressive eccentric exercise program that was aimed at overloading the affected patellar tendon in order to encourage collagen synthesis and improve tensile strength of the tendon. While there are few studies evaluating eccentric training as a treatment for patellar tendinosis, the eccentric training program used during this patient's rehab reflected the positive results found in studies by Alfredson et al.[9,10] They found that eccentric training was superior to concentric training in patients with patellar tendinosis. Furthermore the addition of a decline in performing eccentric squats showed superior results when compared with patients performing flat-step squats.

While diagnosis in cases such as these can be difficult to establish without imaging studies, we feel that this patient's diagnosis of patellar tendinosis was confirmed retrospectively. In treating the patient's impairments and primary complaints by following a progressive eccentric overload to the patellar tendon and closely monitoring the patient's symptom and functional improvements, we feel our initial hypothesis of degradation versus inflammation of the patellar tendon were supported by the successful outcomes.

Despite the promising results seen in this case and those reported in the literature in using eccentric training as a conservative treatment for patellar tendinosis, the variability in treatment protocols in the literature reflects the need for studies outlining an optimal protocol. Additionally, many of the referenced articles study young athletic populations and report the use of 12-week programs in which exercises are performed 7 days per week, twice daily.[3,9,10] These programs require an extreme amount of dedication and time commitment that is not necessarily a plausible option for all patients suffering from this condition. The patient in this case report performed a 6-week program with eccentric training one time per day, 3 days per week with a stretching maintenance program to be performed at home daily. Even with the differences in frequency and duration of this patient's program versus those found in the literature, this patient had equally successful results. Considering these points, there needs to be more randomized controlled trials with larger samples and more diverse subject populations, specifically studying the optimal frequency, duration, and time for an eccentric exercise training protocol in the treatment of patellar tendinosis. Additionally, there is very little quality research that has been published comparing outcomes following surgical versus conservative treatment for patellar tendinopathy. Open patellar tenotomy is the surgical treatment of choice as it is the most widely described. Other surgical options include: curettage of the patella at the tendon-bone junction, percutaneous longitudinal tenotomy, arthroscopic tenotomy and drilling of the inferior patellar pole.[3] Further research comparing surgical to nonsurgical treatment approaches are warranted in order to determine long-term outcomes.

To our knowledge, no studies describing the use of eccentric overload strengthening for the treatment of patellar tendinosis provide a detailed comprehensive intervention protocol. The literature supports the use of the eccentric decline squat as a single intervention for patellar tendinosis, but does not specifically describe any ad-



Starting position

Squat descent on right lower extremity

Placement of left lower extremity in preparation for bilateral lower extremity ascent

Figure 1. Eccentric Decline Squat Performed on the Smith Machine

ditional eccentric overload exercises as part of their treatment programs; therefore, it is likely our approach is novel. Our approach is more comprehensive than those we found in the literature since this patient was successfully treated with 3 eccentric overload exercises in addition to the eccentric decline squat. A strength of this case report is the detailed description of the prescribed interventions. We feel that this will lend well to reproducibility in undertaking such eccentric exercise protocols in the future. Furthermore, as patellar tendinopathies are often associated with jumping sports, few studies have examined this pathology in weightlifters. This study provides evidence of the use of eccentric overload exercise in the successful treatment of tendinopathy in an individual of an understudied population. Additional strengths of this case study are the use of knee specific questionnaires such as the IKDC and Cincinnati to monitor the patient's functional progress and a questionnaire specifically designed to monitor the severity of patellar tendinopathy as it relates to function, the VISA. There are a few limitations to consider when interpreting the results of this study. As with any case study, the authors are limited in their ability to establish a cause and effect relationship between our interventions and outcomes of interest. Another limitation to note is that no minimal clinically important differences (MCID) were reported for the questionnaires that were used in monitoring the patient's functional outcome measures. We are therefore unable to make any judgments regarding the clinical significance of the changes in self-reported function following treatment based on MCID measures. We believe that, despite having no objective proof of a clinically important difference, this patient experienced clinically significant improvements due to his subjective reports that he was "back to normal."

This case report describes the use of a comprehensive eccentric overload training protocol in the treatment of an Olympic-style weightlifter with signs and symptoms of patellar tendinosis. The patient was able to report successful improvement in symptoms and function by using a similar, yet more comprehensive eccentric overload program than those found in the literature. While the interpretations able to be drawn from this case are limited, we believe it presents another potential option for the use of eccentric overload training in the treatment of patellar tendinosis and warrants consideration for further study.

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