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AN ATHLETE AND PATELLAR TENDINOSIS: A CASE STUDY

by

Lisa Monson

A Scholarly Project Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine and Health Sciences

University of North Dakota

in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy

Grand Forks, North Dakota
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This Scholarly Project, submitted by Lisa Monson in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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(Graduate School Advisor)

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(Chairperson, Physical Therapy)

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ABSTRACT

Background and Purpose: Patellar tendinosis is a pathology among young athletes with research being conducted about it every year. This single patient case study goes through the examination and evaluation leading to a diagnosis along with the treatment, outcomes, and discussion of this patient and patients recorded in other research studies.

Case Description: This case report was conducted on a 15 year old male presenting with left patellar tendinosis. Treatment lasted eight weeks with emphasis on eccentric quadriceps exercises and return to sport activities.

Outcomes: The results of conservative treatment for this young athlete were successful. The Functional Movement Screen was utilized to quantify his ability to return to his full sporting volume. By the end of eight weeks, he had a complete return to basketball and tennis without pain or limitation.

Discussion: Eccentric exercise has been shown in many studies to have superior outcomes when compared to any other conservative treatment. However, eccentric exercise combined with hip strengthening or static stretching has resulted in significantly better outcomes than eccentric exercise alone. This combination of treatment was used successfully with the patient in this case study, leading to improved function and sports participation.

Conclusion: Patellar tendinosis is an overuse injury that athletes in particular tend to acquire. The present study shows the importance of physical therapy services, and the research behind it, in order to help these patients return to the activities they enjoy. Eccentric exercise and hip strengthening were the most prominent interventions used, which has been shown in this case study, as well as other research studies, to have positive outcomes. As a result, this patient was able to make a complete recovery within eight weeks and return to basketball and tennis without pain.

CHAPTER I

BACKGROUND AND PURPOSE

Introduction

Patellar tendinosis is a more prevalent and recognized pathology among young and elite athletes, especially those athletes who overwork their tissue and do not allow the proper amount of time needed for recovery. The prevalence rate among elite athletes is 14%. However, an increased prevalence of 40-50% has been noted in elite volleyball players.[1-3]

The initial onset of patellar tendinosis is usually associated with a change in training volume, type, technique, equipment, or surface used. Typically, patellar tendinosis presents with a gradual onset of anterior knee pain associated with increased loading to the joint, and focal tenderness with palpation to the patellar tendon. Also associated is an impedance of their athletic performance and participation. As a result of suffering from patellar tendinosis for a prolonged period of time, an elite athlete may be forced to prematurely retire his or her career. However, conservative treatment has been found to have encouraging results in 90% of patients with mild symptoms.

The properties of tendons change as a result of the continuous stresses applied to them, and the tendon continues to change in its morphology and elastic properties as the tendinopathy worsens. Tendon fibers become disrupted and disorganized causing increased tendon thickness and cross-sectional area, as well as fiber type changes and an increase of collagen cross-link concentrations. Increased tendon thickness has been linked to increased pain. Tendon changes may also affect its

function throughout every day functional activities.

Patellar tendinosis is an overuse injury that does not have a clear etiology. A few theories have been proposed, but they are unable to capture a complete understanding of this pathology. A few studies[3,4] have found patellar tendinosis to have a higher prevalence in males and individuals with a more physically demanding occupation, yet a similar study[5] recorded an equal prevalence for both females and males. Other risk factors for developing patellar tendinosis include: high training volume, rigid landing technique, high body mass index (BMI), high jump performance, and limited quadriceps and hamstrings extensibility.[1,3-5] Basketball players have also been shown to have one of the highest prevalence rates of patellar tendinosis, justifying the importance of this case study.

A systematic review by Wasielewski and Kotsoko[6] looked at the treatment of patellar tendinosis, specifically eccentric exercise compared to other forms of therapeutic exercise and therapeutic agents for the greatest reduction in pain and improvement in strength. The results showed that eccentric exercise was superior to therapeutic agents, but not definitively better than other forms of therapeutic exercise. Best results were found with a combination of rest from competitive activities/sports and eccentric exercise. Further research[7] has shown that decreased training volume without complete termination of the irritating activity was beneficial, while immobilization of joints has been shown to attribute to decreased tendon strength. Patients should be instructed to rest from strenuous activities that excessively load the patellar tendon, for 4-6 weeks, to ensure maximal healing and a reduction in their symptoms.[6]

Dry needling, sclerosing injections and hyperthermia thermotherapy

have all been newly researched treatments for tendinosis that have shown promising results.[6,8,9] Surgery continues to be the last form of treatment and is only utilized after conservative treatments have failed.[9] One study, with a seven year follow up, found that surgical intervention was a viable solution after conservative treatment failed; surgery corrected and alleviated symptoms associated with patellar tendinosis. Surgery demonstrated a success rate of 91% within the unilateral tendinopathy group and 83% within the bilateral group.[10] Finally, a potential preventative intervention could help to identify the amount of vascularization and intratendinous changes of the tendon, that have been associated with tendinosis later in life.[5]

In this case study, high training volume and a rigid landing technique contributed to the patient having an increased risk for injury. This case study looks at the process of diagnosis, treatment, outcomes, as well as the cost of patellar tendinosis in a young man who has led an active lifestyle.

CHAPTER II

CASE DESCRIPTION

History

Patient is a fifteen year old male in his freshman year of high school. He is active with tennis and basketball. The patient has asthma and uses an Albuterol inhaler, and has a history of Osgoods Schlatter disease and bilateral pes planus. He presents with left anterior knee pain that limits his participation in basketball and tennis practices, games, and matches. No pain is produced while at rest, however repetitive jumping aggravates his symptoms. He has been battling knee pain for nine months after a player fell onto him during a basketball game in January 2014. However, he continued to play basketball thinking the pain would resolve, but it continued to flare up. He was previously able to participate in tennis and basketball practices, matches and games, but can no longer participate fully due to the severity of his pain. This is the patient's first attempt at formal treatment and rehabilitation for his knee pain. The patient's goal, by discharge, is to return competitively to these sporting events.

Systems Review

A minimal systems review was accomplished: the integumentary system was intact with no noticeable scarring or changes in skin color or integrity; the patient appeared to be of typical height and normal weight for his age; he was oriented to time, place, person, and circumstance; and he communicated appropriately.

The musculoskeletal examination (table 1) noted bilateral knee range of motion was within normal limits. Resisted isometrics (RIMs) were weak and

painful with left knee extension. Gluteus maximus strength was 4/5 bilaterally and gluteus medius was 3+/5 on the right and 4/5 on the left. Ambulation was completed with inspection of gait, which showed bilateral genu valgus and left foot pronation during stance phase.

TABLE 1 – Musculoskeletal Examination

Measures	Right Results	Left Results
Reflexes • **Knee Jerk (L4)** • **Ankle Jerk (S1)**	 **2+** **2+**	 **2+** **2+**
RIMs • **Knee extension** • **Knee flexion**	 **Strong and painless** **Strong and painless**	 **Weak and painful**** **Strong and painless**
MMT • **Gluteus Medius** • **Gluteus Maximus**	 **4/5** **4/5**	 **3+/5** **4/5**
Palpation	**No pain**	**Tender at central inferior patellar tendon, rectus femoris, and TFL**
Pes Planus	**Present**	**Present (> right)**
Knee AROM	**0˚-140˚**	**0˚-140˚**
Knee PROM	**-2˚-145˚**	**-2˚-145˚**
Gait	**Genu valgus**	**Genu valgus and foot eversion/pronation during stance phase**

**Left knee infrapatellar tendon painful with manual resisted knee extension with knee flexed to 130˚.

EXAMINATION

Tests and Measures

Baseline data was collected for flexibility, range of motion, strength, and ligament and meniscal integrity (Table 2). Sensitivities and specificities of examination procedures are reported in Table 3. The Thomas test was used to test the flexibility of rectus femoris and iliopsoas and proved to be positive for iliopsoas and rectus femoris tightness bilaterally. Valgus and varus stress

tests were used for medial collateral ligament (MCL) and lateral collateral ligament (LCL) integrity, respectively. Anterior drawer and posterior drawer testing for anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) integrity, respectively. Patient presented without a leg length discrepancy. Patellar compression was used to rule out articular damage to the patellofemoral joint; if positive, the patient's pain would have been reproduced. However, this test can be painful even with non-symptomatic knees. Single leg balance was tested with eyes open resulting in good balance on the right and only fair balance on the left due to increased sway and use of balance strategies. Testing for meniscal damage was completed using Apley's Compression and Deep Knee Bend (deep squat with full knee flexion) tests. Patient also complained of pain at the inferior pole of his patella. While a functional outcome scale was not utilized the patient was initially unable to participate in basketball and tennis. No activities of daily living (ADLs) or other functional activities were affected.

TABLE 2 – Special Test Initial Results

Special Tests	+/- Right	+/- Left
Thomas Test • **Rectus Femoris** • **Iliopsoas**	 **+** **+**	 **+** **+**
Valgus Stress	**-**	**-**
Valgus Stress	**-**	**-**
Varus Stress	**-**	**-**
Varus Stress	**-**	**-**
Anterior Drawer	**-**	**- (Grade 1 laxity noted)**
Posterior Drawer	**-**	**-**
Leg Length Discrepancy	**-**	**-**
Patellar Compression	**-**	**-**
Single Leg Balance • **Eyes Open**	 **Good**	 **Fair**
Apley's Compression		

• **Medial Rotation** • **Lateral Rotation**	- -	- -
Deep Knee Bend	-	-
Trendelenburg	-	-

*Data from the initial examination

TABLE 3 – Special Test Rigor

Special Tests	Reliability	Validity	Specificity	Sensitivity	LR+	LR-
Valgus Stress[11,12]	K=.16	K=.16	N/A	.86	N/A	N/A
Varus Stress[13]	.56-.68	N/A	N/A	.25	N/A	N/A
Anterior Drawer[14]	N/A	N/A	.92	.55	7.3	.48
Posterior Drawer[15]	N/A	N/A	.9	.99	.1	90
Patellar Compression[16]	Low	N/A	.67	39	1.18	.91
Apley's Compression[17]	N/A	.8	.71	.84	2.9	.2
Palpation Tenderness[14]	.82	N/A	.09	.68	.74	3.55
Pain Scale[18]	.63	.86	N/A	N/A	N/A	N/A
ROM[19]	.98	.97-.98	N/A	N/A	N/A	N/A
MMT[20]	.97	N/A	.35	.90	3.5	N/A

EVALUATION

The patient's presentation was consistent with patellar tendinosis, with no complicating factors that necessitated a referral. The patient's pain was localized at his left inferior patellar tendon, left knee extension RIMs were weak and painful, and limitations with participation in basketball and tennis supported the diagnosis of patellar tendinosis. Additional contributing factors include bilateral hip weakness and diminished recruitment as shown through MMT and single leg stance. Also pertinent was his history of bilateral Osgoods Schlatter disease and bilateral pes planus; greater with left versus right foot. These factors contributed to inefficient joint stability during closed chain, repetitive jumping and directional changes during tennis and

basketball. Ligamentous, meniscal, and various other knee pathologies were ruled out through the negative results of varus/valgus stress, anterior drawer, posterior drawer, Apley's compression, deep knee bend, leg length discrepancy, and patellar compression tests. Due to previous experience with this type of injury and how it should be treated, the decision was made to accept this patient for physical therapy services.

DIAGNOSIS

Signs and symptoms were consistent with left patellar tendinosis along with reduced recruitment and strength of gluteus maximus and gluteus medius. This diagnosis was found to be in practice pattern 4D: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Connective Tissue Dysfunction with a medical diagnosis of pain in joint, lower leg (ICD9: 719.46). The diagnosis was also found in practice pattern 4E: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Localized Inflammation with a second medical diagnosis of patellar tendinitis (ICD9: 726.64). As of now there is no specific ICD9 code for patellar tendinosis, so patellar tendinitis was used instead.

PROGNOSIS & PLAN OF CARE

Patient was expected to make a full and complete recovery with physical therapy two times a week for six to eight weeks. In the short term, the patient completed an individualized, specific, supplemental home exercise program with emphasis on impairments. Long term rehabilitation goals included: increasing hip abductor and extensor strength to 5/5 bilaterally,

increasing quadriceps and hip flexor flexibility to produce a negative Thomas test, remodeling of the left patellar tendon to tolerate weight bearing and sport specific dynamic eccentric loads, and that the patient will participate in both tennis and basketball competitively without pain or limitation. The patient's pain and musculoskeletal status were monitored, reevaluated, and documented throughout his visits. Formal reevaluation was completed on the ninth visit and at discharge. Criteria for discharge from physical therapy included a: return to repetitive jumping, tennis and basketball practice, matches and games without pain or limitation. This patient's home program included range of motion, strength, and endurance exercises; stability, balance, and proprioception training; muscle re-education; coordination exercises; and soft tissue mobilization (Appendix II). These interventions were supported by research, patient specific, and designed to promote optimum healing in the proper amount of time. The incorporation of these interventions into his daily routine helped him to gain strength and remodel his patellar tendon to allow for maximal participation in all activities.

INTERVENTIONS

Soft tissue massage/mobilization (STM), in the form of trigger point and myofascial release, was the first mode of treatment used (Table 4a). STM was used to decrease guarding of rectus femoris, vastus lateralis and gluteus medius and to promote increased recruitment and vascularization in these areas. Cross friction massage of his left patellar tendon was used to break down adhesions in the tissue and to help with realignment of collagen. Superior and inferior patellar mobilizations were also utilized to promote full knee range of motion and proper tracking of the patella.

Eccentric quadricep exercises were selected to help reshape the tissue. Initial eccentric exercises included five inch forward, backward and side step downs and prone knee flexion with cable resistance. These exercises were progressed to higher step downs, jump downs, and eventually jump ups and frog hops (jumping with both feet over a 6” or 12” hurdle). Mini trampoline jumping was utilized to reduce the force on the patellar tendon while jumping. Cable resisted side stepping was utilized for closed chain, functional strengthening of gluteus medius. A progression to cable resisted side jumping over 6” or 12” hurdles and weighted side lying hip abduction arcs were promoted for strengthening of all fibers of gluteus medius (Table 4b). Single leg balance reaching of 36”, skater circumduction drill, Bosu ball squats, and single leg medicine ball rebounder were utilized to work on overall balance, stability, and proprioception. The Thomas stretch was also utilized to increase flexibility of rectus femoris and iliopsoas (Table 4c). Ladder and cone drills were used for agility and footwork for progression to tennis and basketball (Table 4d). Lastly, an ice massage was applied to his left patellar tendon for pain reduction and to minimize swelling and inflammation that may occur following exercise. Throughout all therapeutic exercises, emphasis was placed on having good knee mechanics through prevention of knee genu valgus posture, and having an equal distribution of weight bilaterally.

Patient education was introduced at the initial evaluation and was continued throughout treatment of this patient. Emphasis was especially placed on his HEP (Appendix II) as well as his gradual return to tennis and basketball. The patient’s mother was present for almost every treatment session and would remind her son to complete his HEP each day and monitor his sports participation to ensure he was not overworking his tendon or

causing an exacerbation of symptoms. For this patient, it was not deemed necessary to discontinue his sports participation, as it was another way to monitor his progression. At home, he was extremely adherent.

TABLE 4a – Manual Therapy Interventions

Soft Tissue Mobilization	Frequency	Duration
Myofascial Release	1-2x/week for 4 weeks 0-1x/week for 2 weeks	30 min. for 4 weeks 15 min. for 2 weeks
Trigger Point Release	1-2x/week for 4 weeks 0-1x/week for 2 weeks	30 min. for 4 weeks 15 min. for 2 weeks
Cross Friction Massage	1-2x/week for 4 weeks 0-1x/week for 2 weeks	30 min. for 4 weeks 15 min. for 2 weeks
Patellar Mobilization	1-2x/week for 4 weeks 0-1x/week for 2 weeks	30 min. for 4 weeks 15 min. for 2 weeks

*All methods of STM were used in multiple combinations for 30 or 15 minutes/session for the first 6 weeks

TABLE 4b – Strengthening Interventions

Strength Exercises	Musculature Targeted	Frequency with Progression	Ht./Wt.
Step Downs	Eccentric Quadriceps	15x2 – 20x3	5-14”
Jump Downs	Eccentric Quadriceps	15x2 – 25x3	5-14”
Prone Knee Flexion	Eccentric Quadriceps	15x3 – 20x3	2-5k
Step Ups	Concentric Quadriceps and Gluteus Maximus	15x2 – 20x3	5-14”
Jump Ups*	Gluteus Maximus	7x1 – 15x2	5-14”
Frog Hops*	Gluteus Maximus Hamstrings, and Quadriceps	4 – 8 lengths	6” & 12”
Cable Resisted Side Stepping/Jumping	Gluteus Medius, Abdominals	5x1/side – 20x2/side	5-10k
Caudal Trunk Rotation	Gluteus Medius	15x2/side – 20x2/side	2.5-5k
Supine Hip ABD/ER	Gluteus Medius	7x3/side – 20x3/side	3-4k
Side Lying Hip Abduction Arcs	Gluteus Medius	1x10/side – 20x3/side	3-5lbs
Vigor Gym	Gluteus Maximus Hamstrings, and Quadriceps	20x2 – 25x2	L6-L10
Bridges	Gluteus Maximus and Abdominals	20x1 – 20x1	gravity

High-Low Chops	Abdominals, Gluteus Maximus	10x2/side – 15x2/side	6-8k
Prone Hip Extension	Gluteus Maximus	15x2 – 20x3	gravity

*Specific use for basketball application; power and explosiveness for jumping.

TABLE 4c – Balance and Stretching Interventions

Balance and Stretching Exercises	Frequency with Progression	Material Needed
Single Leg Diagonal Balance Reach	10x1/side – 30x1/side	Two benches/tables of equal height
Bosu Ball Squats	10x1 – 20x2	Bosu ball
Skater Circumduction Drill	10x1/side – 30x1/side	Something for under the lower extremity in motion
Single Leg Medicine Ball Rebounder	15x1/side – 20x2/side	Rebounder and medicine ball
Mini Trampoline Jumping/Marching	30sec.x1 – 60sec.x3	Mini trampoline
Thomas stretch*	20sec.x1 – 30sec.x2	High table or bed

*Stretching Exercise

TABLE 4d – Agility/Return to Sport Interventions

Agility	Frequency with Progression	Material Needed
Ladder Drills	2 – 8 lengths	Flexible ladder
Cone Drills	4 – 8 lengths	6 cones
Shuffling	100'x2 – 100'x4	A hallway
Karaoke	100'x2 – 100'x4	A hallway
Resisted Run Backs	15'x10 – 15'x20	Cable system, 5-12k or theratubing
High Knee Skip/Hop	100'x4 – 100'x6	A hallway

OUTCOMES

The patient was compliant with his HEP and activity recommendations; he responded well to treatment. At discharge, gluteus maximus and medius muscles tested at 5/5 bilaterally (Table 4). Left knee extension RIMs were used to reassess improvements in strength and reductions in pain. At discharge his lower extremity RIMs were strong and painless bilaterally. The Thomas test was repeated to observe changes in the length of rectus femoris and iliopsoas, which were found to be negative bilaterally. For discharge, the

Functional Movement Screen (FMS) (Appendix I) was used to quantify his return to functional and sport related activities at a competitive level (score >18/21). He was able to score 20/21, showing that he had returned to a level that he could fully participate in his sporting events. The point missed was with the trunk stability push-up. FMS rigor can be found in Table 6.

Throughout treatment, the use of soft tissue mobilization and eccentric strengthening of the quadriceps helped to remodel the tissue of his patellar tendon promoting decreased pain and greater efficiency within his knee joint. By discharge, all of the patient's goals had been met and he was able to participate fully in basketball and tennis practice along with tennis matches without pain limitation. The patient and his mother were both very pleased with his progress and articulated that he would continue with his home exercise program as a supplementary workout to basketball and tennis.

In the future, it is likely that he will become a healthier athlete because of this injury. He was provided with the exercises and education that were necessary to maintain healthy tissue alignment, increase his strength, and improve his overall power and endurance. All of those exercises are extremely important for basketball and tennis with the amount of jumping and cutting needed.

TABLE 5 – Discharge Outcomes

Measures	Right Results	Left Results
Reflexes • **Knee Jerk (L4)** • **Ankle Jerk (S1)**	 **2+** **2+**	 **2+** **2+**
RIMs • **Knee extension** • **Knee flexion**	 **Strong and painless** **Strong and painless**	 **Strong and painless**** **Strong and painless**
MMT • **Gluteus Medius** • **Gluteus Maximus**	 **5/5**** **5/5****	 **5/5**** **5/5****

Palpation	**No pain**	**No pain****
Pes Planus	**Present**	**Present (> right)**
Knee AROM	**0˚-140˚**	**0˚-140˚**
Knee PROM	**-2˚-145˚**	**-2˚-145˚**
Gait	**Genu valgus**	**Genu valgus and foot eversion/pronation during stance phase**
Thomas Test • **Rectus Femoris** • **Iliopsoas**	 **- **** **- ****	 **- **** **- ****
Single Leg Balance • **Eyes Open**	 **Good**	 **Good****
Functional Movement System	**20/21*****	**20/21*****

**Change observed and documented
***Only completed at discharge

CHAPTER III

DISCUSSION

DISCUSSION

In this case study, the patient was able to completely recover and return to his sporting activities pain free. Current literature has not always shown complete recovery from patellar tendinosis. Eccentric exercise was the intervention of choice with a progression to concentric exercises as tolerated, which was supported with research.[6,8] Soft tissue mobilization and stretching were also deemed appropriate for this patient as he had tightness and guarding of his left kinetic chain. These interventions, in combination with eccentric exercise has been shown to be a superior form of treatment which has provided significantly improved overall function and reduced pain in patients with patellar tendinosis for at least six months, when compared to eccentric exercise alone.[21] Hip strengthening was incorporated into this patient's plan of care and proved to be beneficial in helping him regain power and stability with running and jumping. In accordance with the study by Wasielewski and Kotsko[6] eccentric exercise in combination with hip strengthening, was proven to be a beneficial and effective treatment for patients with patellar tendinosis.[6]

Evidence in previous studies supported the use of the exercises utilized in this case study. Benefits from exercises included: reduced pain as well as increased strength, power, and function. Eight weeks of physical therapy intervention including eccentric exercises and manual therapy techniques facilitated remodeling of the patellar tendon. Another reason the patient responded so well to treatment was because of his compliance to his home exercise program and the support and encouragement of his family. A

limitation of this study was that it was a singular case study, so a larger number of patients need to be studied with the same exercise program to record if the same results were attained.

Reflective Practice

A thorough history was shown to be a crucial part of the examination for these patients, with an emphasis on transitions between activities.[7] There are a few questions that were not asked within the initial evaluation that would have helped establish an even clearer picture of the diagnosis. Had his practice volume increased recently? Did he change sports to one with different basic movements required, such as: switching from a lot of running to a lot of jumping? Did he feel as though he was working harder or at a much greater workload than before?

With this patient, a systems review was not thoroughly completed. This was due to the patient's age and activity level. His height and weight were estimated to be WNL and therefore were not measured directly. The patient had no signs of integumentary inconsistencies, therefore no further tests or referrals were necessary. Cardiopulmonary tests such as blood pressure and Oxygen saturation were not completed as no issues had been presented in his past medical history.

During the initial evaluation, it would have been very beneficial to have an objective measure for pain. An algometer is a device capable of performing this task. Athletes with patellar tendinosis were found to have a significantly lower pain pressure threshold than athletes without knee pain ($p<.001$). The pain pressure threshold of athletes involved in jumping sports was also significantly lower compared to non-jumping sports ($p<.01$). For use as a

diagnostic tool, if an athlete's pain pressure threshold was below 36.8N, then there was found to be a 96.5% chance that this athlete had patellar tendinosis. Pain pressure threshold algometry can be considered a reliable and objective way to measure pain in patients with patellar tendinopathy (Table 6). In this study, there was a wide variety of sports included, so the results can be generalized to a larger population and implemented into the clinic.[22,23] In the future, physical therapists should include this type of objective measure into their initial evaluation of a patient with patellar tendinosis, as pain in the patellar tendon has been found to be one of the predominant symptoms. Ideally the FMS would have also been used at the initial evaluation and at least once prior to discharge.

Another part of the initial evaluation that should have been included was the use of a functional scale. The lower extremity functional scale (LEFS) is a reliable and standardized test for lower extremity pathologies (Table 6). It consists of 20 questions and has a maximum score of 80; greater disability is associated with a lower score. This measure is free to use and an efficient use of time to objectively measure functional limitations.[24]

In the future, with the use of the Thomas test, I would use a goniometer to measure the angle of the patient's knee and hip. These angles would help to objectively measure the flexibility of rectus femoris and iliopsoas. One intervention that I would increase is stretching. It has been shown to be a beneficial intervention when combined with eccentric exercise. When working with patients with patellar tendinosis, I plan to emphasize the use of stretching more frequently and consistently before and after sporting practices and games.

TABLE 6 – LEFS, Algometry, and FMS Rigor

	LEFS	Algometry	FMS[25]
Reliability	**86%**	**93%**	**74-76%**
Sensitivity	**N/A**	**96%**	**N/A**
Specificity	**N/A**	**97%**	**N/A**
Standard Error	**3.9 points**	**N/A**	**N/A**
MDC	**9 points**	**N/A**	**2.07-2.54**
LR+	**N/A**	**28.7**	**N/A**
LR-	**N/A**	**.05**	**N/A**

If I were to have another patient identical to this one, there is not much that I would change. The plan of care for this patient seemed very appropriate. There was only one referral which was deemed necessary; to acquire orthotics for his excessively pronated feet. This patient would not have benefitted from any other referrals as his injury was orthopedic in nature and a physical therapist would be the ideal health care professional to handle this diagnosis. Through the research that has been established, eccentric exercise seemed to be the intervention with the most evidence supporting it. I was unable to find articles pertaining to the use of manual therapy for patellar tendinosis. However, for this patient it was very appropriate as he had muscle guarding and tightness that contributed to his symptoms. One change I would make to his plan of care would be to give him more specific progressions of his HEP with a specific level of sports participation included. Another change would be to have him rest from his sporting events throughout the first six weeks of treatment as this has been supported through research to help with the healing process.[6]

As the evidence surrounding the diagnosis of patellar tendinosis continues to progress, there is still much that needs to be taken into account. In the future, I would like to see more evidence published about the

prevention of patellar tendinosis and possible risk factor identification. Prevention would be a huge benefit to many elite athletes as they are at a higher risk for developing patellar tendinosis. The more we are able to know about the risk factors, the more this helps with the prevention. Another area is the need for non-surgical interventions for the patients in which eccentric training is ineffective.

As I reflected on the cost of treatment for this young man, I found it was minimal to what it could have been if he had not attempted physical therapy first. I believe that the costs accrued were reasonable for the service provided, as he was able to return to what he enjoyed doing pain free. He also left with a greater understanding of what he needed to continue to do in order to maintain his level of fitness and avoid re-injury. His parents also felt better knowing that they, and the physical therapists, were doing all that was possible to help their son return to his sporting events without pain. In order to keep costs lower, we could have done fewer appointments with greater emphasis placed on his HEP. This sounds good in theory, but I do not think that this would have been as beneficial for the patient and the outcomes might not have been as complete. This is because without the direction, supervision, and verbal cuing with exercises, he might have done them with incorrect form and caused greater harm than good.

Conclusion

Patellar tendinosis is an overuse injury that athletes in particular tend to acquire. The present study shows the importance of physical therapy services, and the research behind it, in order to help these patients return to the activities they enjoy. Eccentric exercise and hip strengthening were the

most prominent interventions used, which has been shown in this case study, as well as other research studies, to have very positive outcomes. As a result, this patient was able to make a complete recovery within eight weeks and return to basketball and tennis without pain.

APPENDIX I

FUNCTIONAL MOVEMENT SYSTEM

http://www.bing.com/images/search?q=functional+movement+system&view=detailv2&&&id=F9252F8AD7F17E396BB6C0E6E02D21AB95A225AB&selectedIndex=1&ccid=OUFphi%2fW&simid=608006222526153133&thid=JN.Bye5FbEVUe7CiDEftHnazg&ajaxhist=0

APPENDIX II

HEP2GO™ FREE HEP Builder

HEP 1

Created September 4, 2014

View at "www.my-exercise-code.com" using code: MWKK6RV

Total 4

Step Down

Start with both feet on a 5" step.
Keeping your involved leg planted on the step, bend that knee and slowly lower down the opposite leg onto the floor.
Make sure your knee does not go over your toes!
Complete both forward and backward directions on each side.

Repeat	20 Times
Complete	2 Sets
Perform	4 Time(s) a Week

Thomas stretch

Lie on a table with one leg hanging off the edge as shown. Pull the other knee to your chest until you feel a stretch in the front of the hip that's hanging off the table.

Repeat	1 Time
Hold	10 Seconds
Complete	1 Set
Perform	20 Time(s)

HIP ABDUCTION - SIDELYING

While lying on your side, slowly raise up your top leg to the side. Keep your knee straight and maintain your toes pointed forward the entire time.

The bottom leg can be bent to stabilize your body.

Repeat	1 Time
Complete	1 Set
Perform	20 Time(s) a Day

BRIDGING

While lying on your back, tighten your lower abdominals, squeeze your buttocks and then raise your buttocks off the floor/bed as creating a "Bridge" with your body.

Repeat 1 Time
Hold 3 Seconds
Complete 1 Set
Perform 20 Time(s) a Day

Total 5

STEP UP

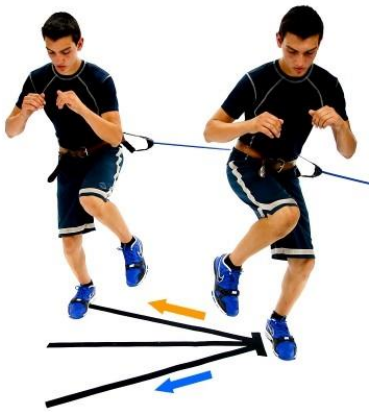
While standing with both feet on the floor, step up a step with one leg. Return backward towards the floor leading with the same leg. Complete forward, backward, and lateral step ups on both legs

Repeat 25 Times
Complete 1 Set
Perform 3 Time(s) a Week

STEP DOWN

Start with both feet on a step.
Keeping your involved leg planted on the step, bend that knee and slowly lower down the opposite leg onto the floor.
Make sure your knee does not go over your toes!
Complete forward, backward, and lateral step ups on both legs.

Repeat 30 Times
Complete 1 Set
Perform 3 Time(s) a Week



TUBING SIDESTEP DIAGONALS

Use a sports cord, elastic band or pulley cable held in your hand. Next, lunge diagonally and BACK to the side. You should land so that your toes continue to point forward. Next, laterally lunge to the original position. On the next repetition, lunge diagonally FORWARD and then back to the original position.

Repeat 25 Times
Complete 1 Set
Perform 3 Time(s) a Week

SIDELYING LEG LIFT ARCS

Lie on your side on a firm surface. Bend the bottom leg for stability as you make an arc/rainbow with the suspended top leg. Perform on both sides.

Repeat 25 Times
Complete 1 Set
Perform 3 Time(s) a Week

HAND WEIGHT DEEP SQUAT

Keep the shoulders over the knees and knees over the toes. Do not allow the knees or feet to rotate away from straight ahead. Sit the hips back as you squat keeping the abdominals tight and the spine still. Upper body must lean forward as you squat.

Repeat 25 Times
Complete 1 Set
Perform 3 Time(s) a Week

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