Massage Therapists' Association of British Columbia

Clinical Case Report Competition

Utopia Academy

April 2013

First Place Winner

Tariq Ali Dossa

Conservative management of patellar tendinopathy

P: 604.873.4467
F: 604.873.6211
research@massagetherapy.bc.ca
massagetherapy.bc.ca

Acknowledgments

The author would like to thank Christine Baseden for her extensive help, insight, patience and support.

The author would also like to thank the patient for his valuable time, enthusiasm and compliance throughout the case study.

Table of Contents

Abstract

Patellar tendinopathy is a troublesome condition that is difficult to treat. Despite the morbidity associated with patellar tendinopathy, its causative factors and pathogenesis are poorly understood. As such, its management lacks clinically based research.

The objective of this case study is to explore the management of patellar tendinopathy through massage therapy and remedial exercise, with hope of contributing to the pool of knowledge we have surrounding this degenerative condition.

The subject is a 34 year old male who first noticed signs of patellar tendinopathy in 2003 after a sudden, uncharacteristic increase in basketball participation. The subject is a competitive squash player, enjoys hiking and is generally an active individual. The subject had received various forms of treatment over the years, with the symptoms having resumed a few months ago.

The case study consists of 10 treatments during which massage and remedial exercise would be implemented. It investigates the conservative management of patellar tendinopathy by evaluating the progression of the quality of pain, gastrocnemius flexibility and lower body power over the course of the treatments.

The results of the case study illustrate a reduction in point tenderness of the lesion sites. Triceps surae flexibility, as measured by straight leg active ankle dorsiflexion, increased over the course study. Additionally, vertical jump scores, which is an indirect measurement of lower body power, also increased. The results of the case study are consistent with present literature that massage, stretching and eccentric strengthening may be beneficial in the management of patellar tendinopathy.

Key words: Patellar tendinopathy, tendinosis, jumper's knee, remedial exercise, conservative management.

Introduction

Patellar tendinopathy is a common condition encountered in sports medicine. It is a clinical condition characterized by activity-related, anterior knee pain associated with focal patellar-tendon tenderness (1-3). It is believed that patellar tendinopathy results from repeated loading of the knee extensor mechanism, and is thus most prevalent in sports involving some form of jumping (4). Patellar tendinopathy occurs in numerous sports, with jumping athletes being the most susceptible (5). For example, the prevalence of patellar tendinopathy is 40–50% among elite volleyball players (6,7). Furthermore, it has been described as the most common knee disorder among competitive athletes (8). Patellar tendinopathy is commonly referred to as “jumper’s knee” (4,5,9-11). However, this term is misleading as this condition is found in a wide variety of athletes, many of who do not partake in activities that include jumping (12-15). The prevalence of patellar tendinopathy varies between 2.5% and 14.4% among non-elite athletes in various sports (16). As mentioned previously, patellar tendinopathy affects athletes of all levels of sport participation but has an affinity for elite athletes (4). As a result, it forces many athletes to limit their training and competition levels for prolonged periods of time, which in turn impairs performance (17). The morbidity associated with patellar tendinopathy can be significant, with perhaps as many as 33% of athletes unable to participate in sport for more than six months (4). Some research suggests that perhaps 50% of athletes with patellar tendinopathy may retire prematurely from their sport as a consequence of their knee impairment (18). An estimated 10% of athletes with patellar symptomatic tendinopathy have to undergo surgery (19).

Once thought of as an inflammatory condition primarily, Jumper's knee has shown to be more degenerative in nature (1-3). The etiology of tendinopathy remains unclear and the lack of consistency in the published literature also reflects this poor understanding of causation (19-23). Nonetheless, patellar tendinopathy is considered an overuse injury of the knee extensor mechanism (24). Clinically, tenderness is typically experience at the inferior pole of the patella. (Fig. 1)

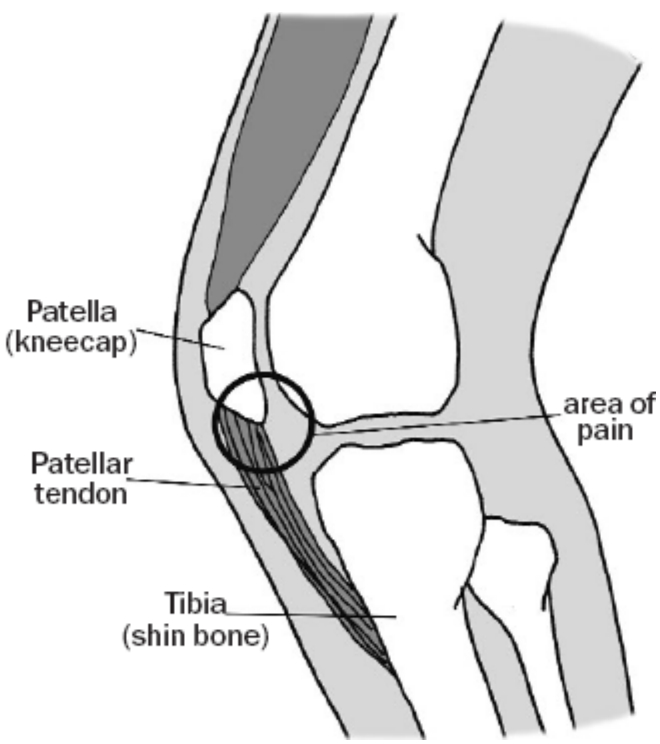

Fig.1: Diagram showing most common location of tenderness at the inferior pole of the patella in patellar tendinopathy.

The predominant pathological feature of patellar tendinopathy is tendinosis, typically in the deep posterior portion of the patellar tendon adjacent to the inferior pole of the patella (25). Tendinosis is characterized by progressive tissue degeneration and the complete absence of inflammatory cells (14). On a macroscopic level, the affected tendon is soft, yellow-brown and disorganized and commonly labeled “mucoid degeneration” (26-28), in contrast to the normal appearance of a glistening, stringy, parallel-organized, white tendon.

As mentioned previously, the precise mechanism by which patellar tendinopathy develops is currently unclear. Similar to most overuse injuries, the pathogenesis of patellar tendinopathy is multifactorial and varies from individual to individual. Nonetheless, they can be categorized into extrinsic and intrinsic factors. Extrinsic factors are more commonly considered to be the causative factor in patellar tendinopathy, specifically repeated mechanical overload (5). Intrinsically, it has been hypothesized that impingement of the inferior pole of the patella onto the tendon may contribute to the pathogenesis (29). Intrinsic factors such as patella alta, abnormal patellar laxity, and muscular tightness and imbalance have also been postulated (8). Of these, only muscle tightness has been shown to be a predisposing factor (8).

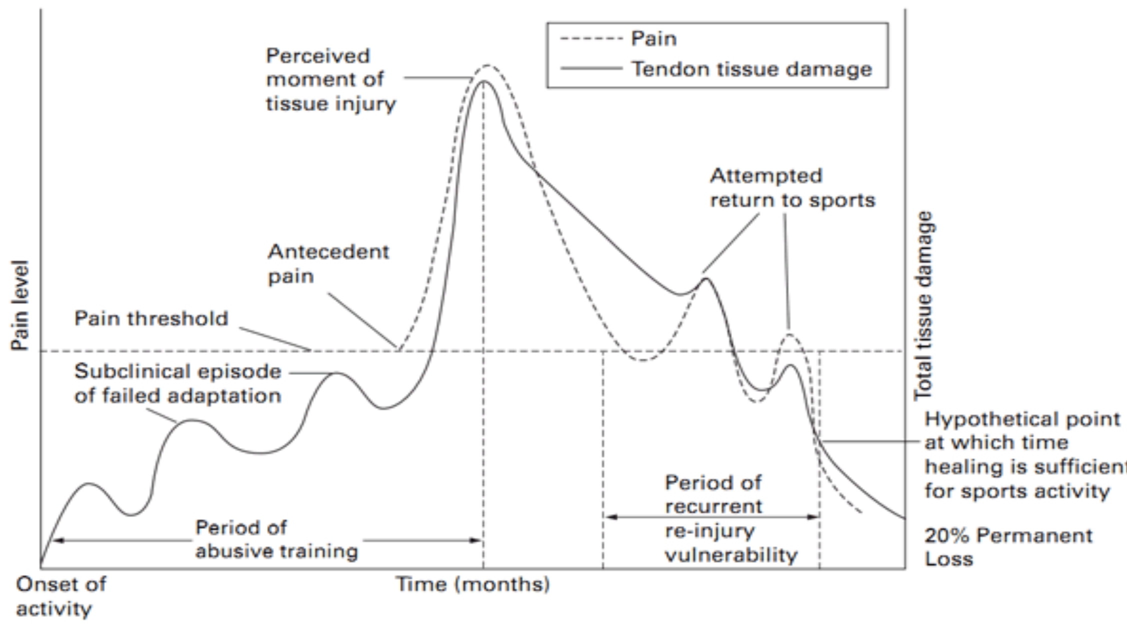

Figure 4 Schematic illustration of pain and tissue damage in overuse tendinopathy. Tendon pathology may begin well before symptoms arise. Therefore recovery may take months, even in patients who present with recent onset of symptoms. Adapted from Leadbetter.[20]

Fig. 2: Graph illustrating the episodic pain and tissue damage associated with overuse patellar tendinopathy.

From the graph above we can see that even if asymptomatic, tendon damage can be present. We also can interpret that if tissue is not allowed to recover, injury is a inevitable. Thirdly, if you return to activity prematurely, you will delay your recovery and potentially prolong it.

Despite the lack of scientific evidence directing the management of patellar tendinopathy, it is generally agreed that the initial management should be conservative (2). Given that the condition is degenerative by nature and that the degeneration was likely taking place before the symptom onset, it is quite possible that the degeneration is advanced before clinical presentation. In chronic cases patellar tendinopathy recovery can be four to six months (2). While in individuals with a short duration of symptoms complete recovery may take two to three months (2). The main goals of conservative management are to deload the tendon and encourage collagen synthesis, maturation and strength, as governed by the patient’s symptoms (2). If possible, this should be achieved through relative rest rather than complete cessation of activity (2). Correction to lower limb biomechanics can improve the energy-absorbing capacity of the lower extremity and reduced the force transmitted to the tendon (24). To further assist the proximal joints in absorbing more load, correction of functional abnormalities, such as the inflexibility of quadriceps, hamstrings and triceps surae, is indicated (30).

Eccentric strengthening exercises have been effective in the treatment of tendinopathies in general (31), though patellar tendinopathy specific studies are yet to be established (13). In some literature eccentric strengthening is accepted as an important part of conservative management of patellar tendinopathy (13, 32).

The most common pharmacological interventions include non-steroidal anti-inflammatory drugs (NSAIDs) and local injection of corticosteroids. One study found little evidence that NSAIDs were of benefit (33) and another study found corticosteroid injections to inhibit collagen synthesis (34). Electrophysical modalities such as ultrasound, laser, and electrical stimulation have been used to treat patellar tendinopathy. At this time however, only circumstantial evidence exists supporting this. The application of ice reduces blood flow and has an analgesic effect and can be used post-loading to manage symptoms (25). Massage therapy is used to reduce adhesions between tendon fibres and promote repair in the management of patellar tendinopathy (35). From a clinical standpoint, in tendinopathy the most effective form of massage appears to be digital ischemic pressure followed by deep transverse friction throughout the entire tendon. Massage should also be performed on both the calf and quadriceps muscles to maintain tissue compliance (30, 35). Patellar tendinopathy is also conservatively managed through taping and the use of straps and braces.

Surgical intervention for patellar tendinopathy is only indicated after six months of well-supervised conservative treatment fails. Surgery may involve excision of degenerated areas, arthroscopic debridement, repair of macroscopic defects, multiple longitudinal tenotomies, drilling of the inferior pole of the patella, resection of the tibial attachment of the patellar tendon with realignment, percutaneous needling, or percutaneous longitudinal tenotomy (35).

The purpose of the case study is to contribute to the pool of knowledge we have on the conservative management of patellar tendinopathy. Individuals with anterior knee problems, athletes, as well as practitioners such as massage therapists, physiotherapists, athletic therapists and chiropractors would all be interested in the deductions of the case study. It is hoped that the findings may prove useful to someone who wants to conduct a more in depth study.

It is hypothesized that massage therapy and remedial exercise will decrease the pain associated with patellar tendinopathy. Furthermore, we will investigate the relationship between the management of patellar tendinopathy and lower body power. We will also ask if improving ankle range of motion in an individual with patellar tendinopathy reduces pain and improve function.

Case Study Subject

The subject in this case study is a 34 year old, non-smoking male, weighing 86.4 kg and standing 183cm tall. He is an active individual in good general health and does not have any pre-existing medical conditions. The subject does not take any medication, has no major injuries and has no history of surgery. The subject works 40 hours a week as a chiropractor both in private practice and with local sports teams.

The subject is a competitive A-division squash player and would typically play two to four times a week. He works out three days a week and would occasionally play volleyball or basketball recreationally. When in season, he would also hike the Grouse Grind once or twice a week. He states his present symptoms prevent him from playing squash, volleyball or basketball. He concedes he is in the midst of opening a new clinic, which may also be limiting his time available. While he has continued to work out, he states he experiences bilateral knee pain when squatting and lunging; thus has limited the weight used and volume of training to tolerable levels.

The subject first noticed his bilateral knee pain in 2003 when he intensely played basketball daily for a week. He reports he was unaccustomed to playing basketball at the time and thus feels the knee pain was a result of the novel activity as well as the volume and intensity at which it was played. He reports initially treating his knee pain with rest and ice. However, due to the ongoing symptoms he had his knees further investigated at chiropractic school. He states the ultrasound showed lesions in his patellar tendons bilaterally. The subject's treatment at that time consisted of laser therapy, Active Release Technique® and Graston Technique®.

At present, the subject has bilateral knee pain at the inferior poles of his patellae. He describes the pain as six out of 10 in severity, with a score of zero being no pain and a score of 10 being the worst imaginable pain. He states the pain is aggravated by running, jumping, squatting, lunging and when climbing stairs. He confirms he does not experience "catching" knee symptoms. He reports his knee pain tends to remain for an hour after initial aggravation. Until a few months ago, he states he was receiving Active Release Technique® and Graston Technique® treatment on and off and was also performing remedial exercise. At times, he reports he would wear a knee strap to permit him to engage in sports. He does not report having sustained any orthopedic injuries to his hips, knees or ankles in the past. During the observation and palpation, no bruising or swelling was noted around the sites of pain. However, there was some warmth felt as well as tension in the muscles and surrounding tendons. Furthermore posturally, the subject exhibited pes planus and genu recurvatum bilaterally.

Methods

Ten treatments were performed on the subject, with sessions lasting 75-90 minutes each. The subject received two treatments a week. Each session consisted of interview, assessment, evaluation, treatment, reassessment and homecare prescription. The subject was asked not to receive any additional treatment on his knees and instructed to limit his workouts to core and upper body strengthening, unless otherwise given as remedial exercise.

Upon completion of the interview portion of the initial assessment (treatment 1), the following tests were performed prior to treatment: Vertical Jump Test, Passive Extension-Flexion Sign (PEFS), Standing Active Quadriceps Sign (SAQS), Ankle active dorsiflexion ROM, Ely's and Thomas Tests were performed as well as a postural exam. Thereafter, Ely's and Thomas Tests were omitted from testing during subsequent treatments. The Vertical Jump Test was the only objective post-treatment test performed. (See description of objective tests below.)

The first three treatments consisted of compressions to gluteals and longitudinal stroking to the entire lower extremity. This was followed by knuckle stroking and NMT to the hamstrings. A passive stretch was then applied to rectus femoris. Open C kneading, NMT and contract-relax stretch were then applied to the triceps surae group, followed by a passive stretch to soleus. With the subject now in supine, effleurage, picking up and NMT were used to treat the quadriceps. Passive stretches were then applied to gluteus maximus, iliopsoas and hamstrings. Patellar tendon x-fibre frictions were then performed for approximately five minutes. A pin and stretch was then applied to the patellar tendon. The remedial exercise given during this period consisted of rectus femoris stretching. Further homecare included the application of ice to his knees for 10 minutes after treatment. Treatments four to six followed a similar treatment protocol as above with the addition of 2-3 sets of 12-15 repetitions of therapist assisted eccentric quadriceps/patellar tendon strengthening. In addition to the application of ice and rectus femoris stretching, gluteus maximus and gluteus medius strengthening was prescribed, as well as triceps surae stretching.

Treatments seven to 10 also followed a similar treatment protocol, with the addition of eccentric decline squats, eccentric split squats and therapist assisted concentric quadriceps/patellar tendon strengthening. The decline squat was given as remedial exercise in addition to the previously assigned homecare.

Test Description

Vertical Jump Test

The Vertical Jump Test involves measuring the difference between the standing reaching height and the peak height reached during the jump. The jumping technique is reviewed with the patient. The patient stands sideways next to a wall mounted with a measuring tape. With feet flat on the ground, the patient reaches up as high as possible. The reach height is recorded. The patient then jumps as high as possible using both arms and legs without shuffling the feet or taking any steps. The wall is touched at the highest point and the score is recorded. The test score is this height minus the reach height.

Fig. 3: Vertical Jump Test Procedure (Indiana Law Enforcement Academy).

Passive Extension-Flexion Sign (PEFS)

This test is used to assess patellar tendinitis. The patient lies supine on the assessment table. The anterior aspect of the extended knee is palpated to define the point of maximal tenderness (Fig. 4), most tenderness to palpation of the tendon is located at the inferior pole of the patella. Once the point of maximal tenderness has been identified, the knee is flexed to 90° and pressure is again applied to the same location on the tendon (Fig. 4). The patient should note a marked reduction to tenderness when the knee is flexed, in order to confirm the diagnosis of patellar tendonitis. The patient evaluates and describes the level of pain provoked during palpation; Zero on the scale being no pain experienced and 10 being the worst pain the patient has ever experienced.

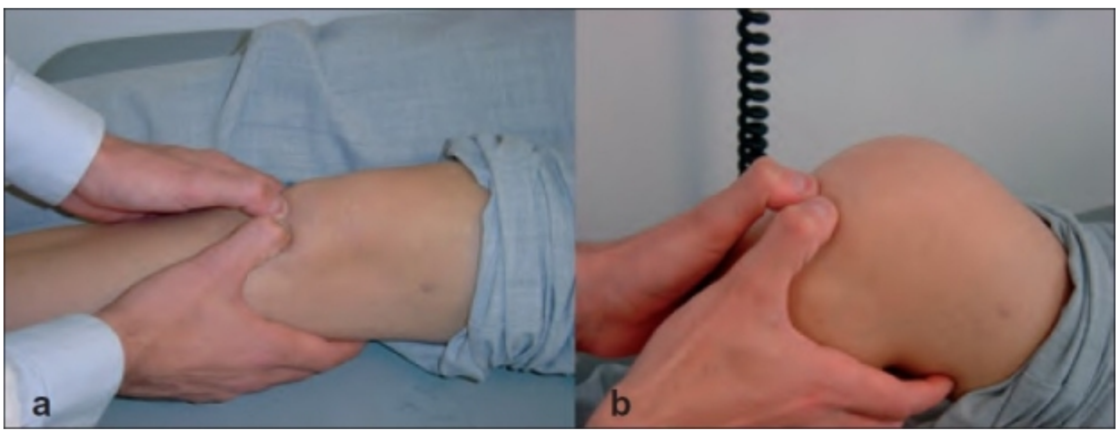

Fig. 4: (Rath et al 2010) Photograph showing palpation of the tendon during the Passive Extension-Flexion Sign a) extension b) 90° of flexion.

Standing Active Quadriceps Sign (SAQS)

This test is used to assess patellar tendonitis. The patellar tendon is palpated while the patient stands. The location of maximal tenderness is identified (Fig. 5). The patient then stands only on the affected extremity with 30° of knee flexion. The location of maximal tenderness is palpated again (Fig. 5). The patient should note a marked reduction to tenderness when the knee is flexed, in order to confirm the diagnosis of patellar tendonitis. The patient evaluates and describes the level of pain provoked during palpation; Zero on the scale being no pain experienced and 10 being the worst pain the patient has ever experienced.

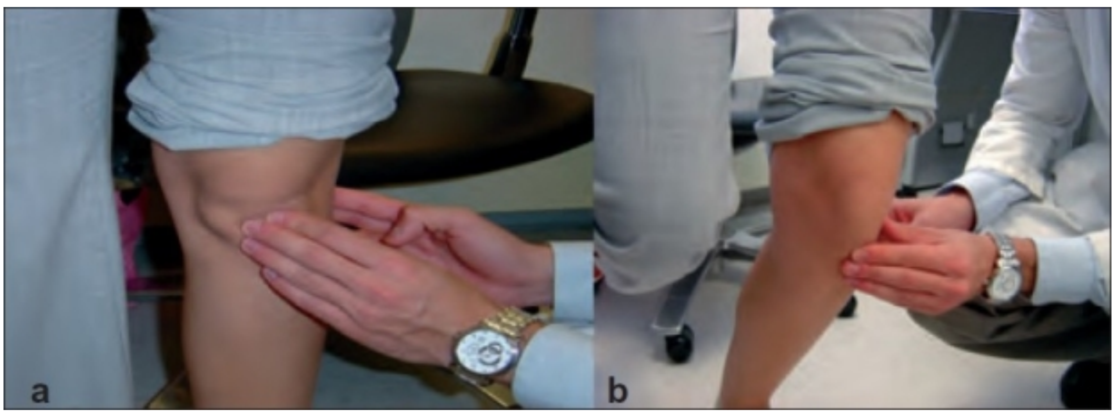

Fig.4: (Rath et al 2010) Photograph showing palpation of the tendon during the Standing Active Quadriceps Sign a) Full weight bearing in extension b) Weight bearing on affected limb only in 30° of flexion.

Ankle Active Dorsiflexion Range of Motion (Gastrocnemius Tightness)

The patient is supine on the assessment table. The stationary arm of the goniometer is aligned with the head of the fibula, the axis of rotation at the lateral malleolus and the moving arm of the goniometer aligned with the fifth metatarsal (Fig. 5). The patient actively dorsiflexes the ankle and the change in angle noted.

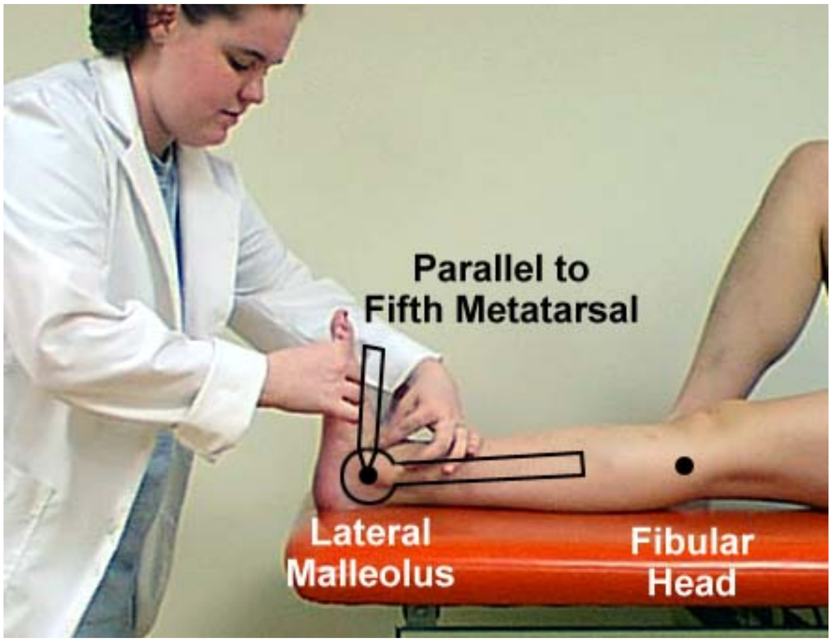

Fig. 5: (Kosmahl Dept of Physical Therapy University of Scranton)

Measurement of ankle dorsiflexion (Gastrocnemius tightness).

Results

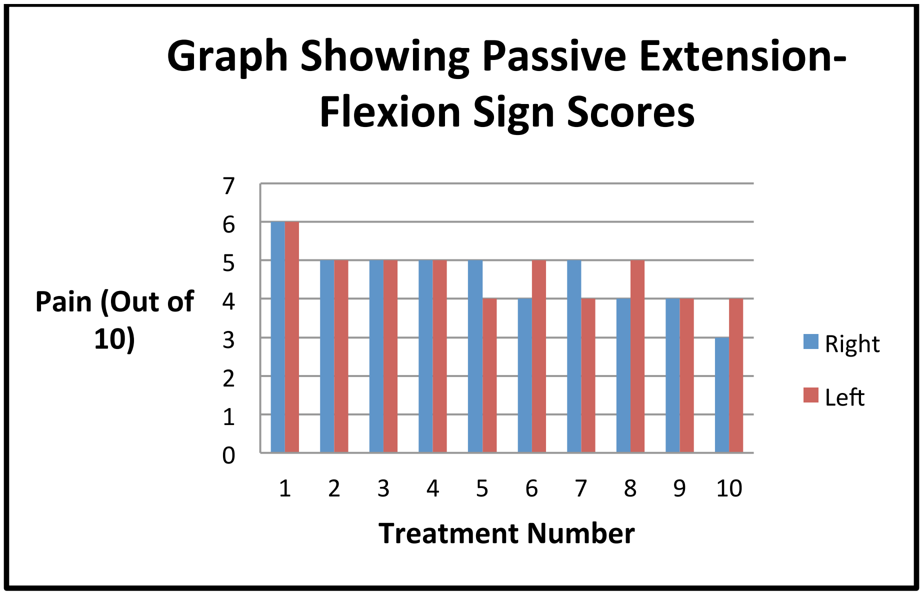

Fig. 13: Reported pain scores as assessed by PEFS before each treatment.

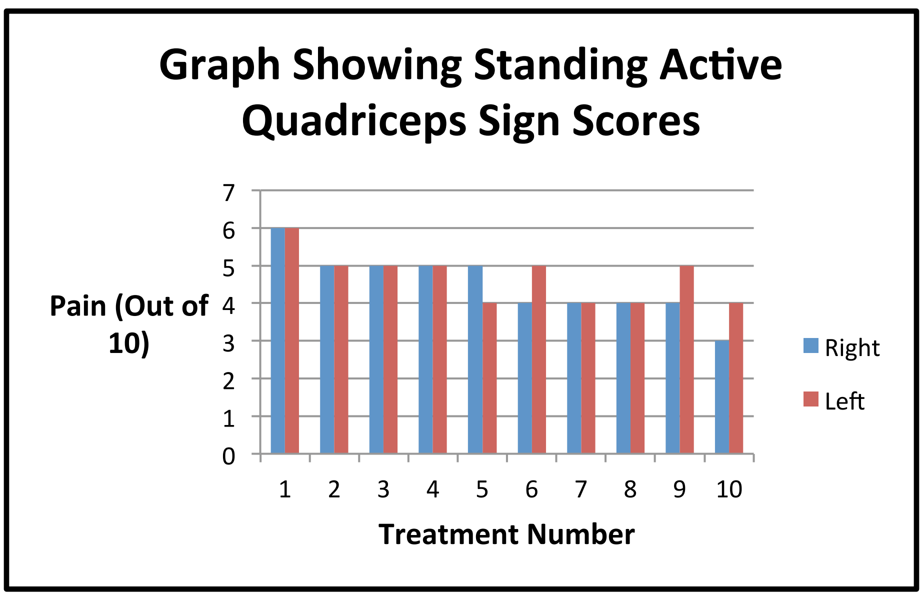

Fig. 14: Reported pain scores as assessed by SAQS before each treatment.

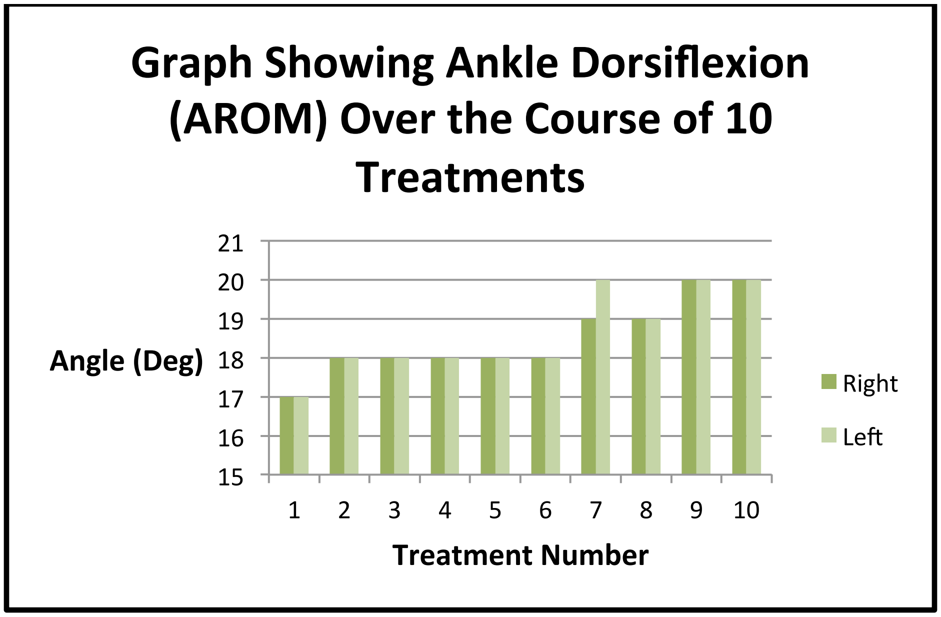

Fig 15: Active ankle dorsiflexion prior to each treatment.

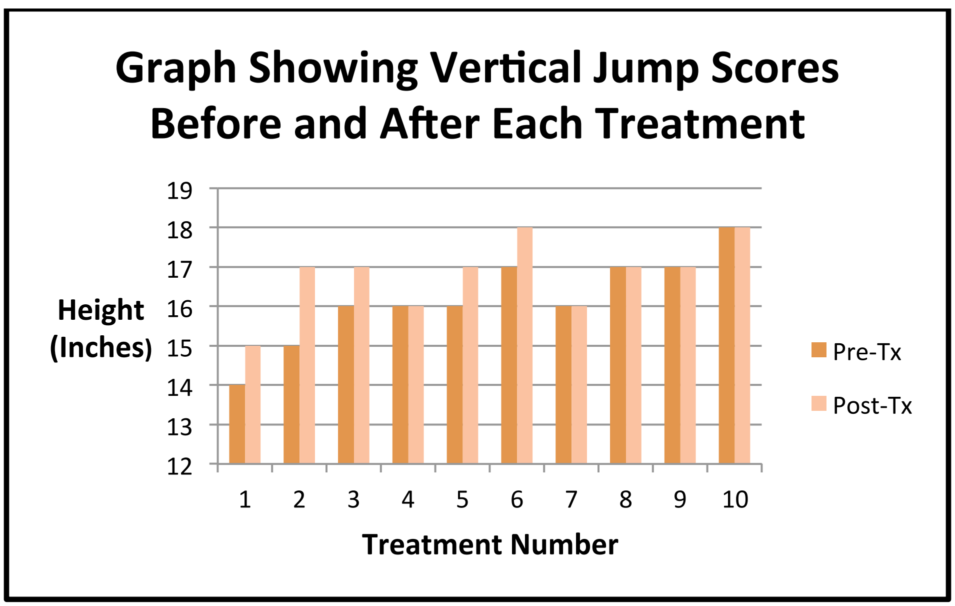

Fig 16: Vertical Jump scores before and after each treatment.

Discussion

The results show a reduction in pain/tenderness over the course of the study, as indicated in Fig. 13 and Fig. 14. This is consistent with the findings of previous work of the effects of massage therapy and remedial exercise on pain management of patellar tendinopathy (13, 23, 25, 30-32, 35, 37, 38). Ankle dorsiflexion improved over the course of the study and is also consistent with the literature that an improvement in triceps surae flexibility in patients with patellar tendinopathy is associated with reduced pain and improved function (30). Looking at Vertical Jump scores, we see a general increase in pre-treatment scores over the course of the study. Post-treatment scores increased initially and there after appear to have plateaued. In general, we see an improved lower body power output upon testing after each of the first six treatments. Thereafter, pre-treatment and post-treatment scores were the same for treatments seven through 10. It is possible that the strengthening performed during treatments one to six reduced the pain in the patellar tendon, improved the flexibility of the treated muscles and warmed the muscles up sufficiently to produce better post-treatment scores. Whereas in treatments seven to 10, eccentric decline squats, eccentric split squats and therapist assisted concentric quadriceps strengthening were added and it is possible that the eccentric nature of the decline squat and split squat exercises contributed to fatigue and thus hindered performance. Similarly, it is also possible that the exercise progression was too hasty, thus impeding performance, as mentioned in previous literature (30). Rehabilitation of patellar tendinopathy can be a lengthy process, especially in those individuals with poor function; athletes with chronic symptoms (>12months) typically require in excess of half a year to recover adequately (32).

The findings of this case study are consistent with the literature on management of patellar tendinopathy. This is encouraging for RMTs as manual therapy combined with remedial exercise seems to be effective in the treatment of patellar tendinopathy. If RMTs can manage pain and reduce injury time, then the individual is less likely to resort to medication and corticosteroid use. This is beneficial to the athlete. Furthermore, if the RMT can facilitate quicker return to sport times and improve function then the athlete is less likely to resort to surgical means. This positively reduces health care costs.

Upon reflection of the study, it is evident that the study should be longer, given the patient has had patellar tendinopathy for many years and that chronic patellar tendinopathy rarely resolves quickly. Numerous modalities were used to treat the patient including NMT, cross-fibre frictions, stretching (pin & stretch, passive and contract-relax) and general Swedish and Petrissage techniques. Furthermore, open-chain eccentric and concentric therapist assisted strengthening, as well as eccentric closed-chain exercises were performed during treatments. Additionally, the patient was given remedial exercise as homecare. In order to establish a better understanding of the management of patellar tendinopathy, fewer modalities should be investigated at one time. Another specific treatment concern is whether or not the pre/post-treatment vertical jump testing adversely affects the overall progress of the bilateral patellar tendinopathy, which of course is worsened by jumping. In this study, the scoring of the provoked palpation during the PEFS and SAQS tests was graded from zero to 10. Various other scoring systems for assessing knee pathology are used but the literature suggests most fail to detect the specific deficits the athletes with patellar tendinopathy possess (39,40). The Victorian Institute Sports tendon Assessment (VISA), a 100 point scoring scale used to assess the severity of patellar tendinopathy based on symptoms and function , has been tested for inter and intra tester reliability (41). This case study may have implemented this assessment given its merit. One additional criticism of the study is that it would have been interesting to see the lasting effect of the treatment by performing a final assessment a few weeks after the last treatment. Future studies may investigate the management of patellar tendinopathy by modalities such as Active Release Technique®, prolotherapy and Graston Technique®, which similar to cross-fibre friction, elicit an inflammatory and repair response.

Conclusion

Patellar tendinopathy is a common overuse injury of the patellar tendon that if difficult to treat. Hence, this condition adversely affects the quality and longevity of participation in sport. Our findings were generally consistent with the literature that both massage therapy and remedial exercise can be used to manage patellar tendinopathy.

However, given that this condition is multifactorial with numerous extrinsic and intrinsic factors, and that the pathogenesis to the precise mechanism is unknown, further research will continue to establish a reliable protocol for the management of patellar tendinopathy.

References

1. Khan KM, Cook JL, Kannus P, et al. Time to abandon the ‘‘tendinitis’’ myth. *BMJ* 2002; 324:626– 7.

2. Khan KM, Cook JL, Taunton JE, et al. Overuse tendinosis, not tendinitis. Part 1: a new paradigm for a difficult clinical problem. *Phys Sportsmed*. 2000; 28:38–48.

3. Maffulli N, Khan KM, Puddu G. Overuse tendon conditions: time to change a confusing terminology. *Arthroscopy*. 1998; 14:840– 3.

4. Cook JL, Khan KM, Harcourt PR, et al. A cross sectional study of 100 athletes with jumper’s knee managed conservatively and surgically. *Br J Sports Med.* 1997; 31:332– 6.

5. Ferretti A. Epidemiology of jumper’s knee. *Sports Med.*1986; 3:289–95.

6. Ferretti A, Papandrea P, Conteduca F. Knee injuries in volleyball. *Sports Med.* 1990; 10:132–8.

7. Lian O, Holen KJ, Engebretsen L, et al. Relationship between symptoms of jumper’s knee and the ultrasound characteristics of the patellar tendon among high level male volleyball players. *Scand J Med Sci Sports*. 1996; 6:291–6.

8. Witvrouw E, Bellemans J, Lysens R, Danneels L and Cambier D. Intrinsic Risk Factors for the Development of Patellar Tendinitis in an Athletic Population: A Two-Year Prospective Study. *Am J Sports Med* 2001; 29: 190-195.

9. Blazina ME, Kerlan RK, Jobe FW et al. Jumper's knee. *Orthop Clin North Am*. 4: 1973; 665– 78.

10. Ferretti A, Conteduca F, Camerucci E, et al. Patellar tendinosis: a follow-up study of surgical treatment. *J Bone Joint Surg.* 2002; 84A:2179– 85.

11. Fritschy D, de Gautard R. Jumper's knee and ultrasonography. *Am J Sports Med*. 1988; 16:637–40.

12. Cannell LJ, Taunton JE, Clement DB, et al. A randomised clinical trial of the efficacy of drop squats or leg extension/leg curl exercises to treat clinically diagnosed jumper's knee in athletes: pilot study. *Br J Sports Med*. 2001; 35:60– 4.

13. Khan KM, Bonar F, Desmond PM, et al. Patellar tendinosis (jumper's knee): findings at histopathologic examination US, and MR imaging. *Radiology.*1996; 200:821–7.

14. Taunton JE, Ryan MB, Clement DB, et al. A retrospective case-control analysis of 2002 running injuries. *Br J Sports Med*. 2002; 36:95 – 101.

15. Zwerver J, Bredeweg SW, Akker-Scheek I. Prevalence of Jumper's knee among non-elite athletes from different sports; a cross sectional survey. *Br J Sports Med.* 2011; 45:310–384.

16. Lian OB, Engebretsen L, Bahr R Prevalence of jumper's knee among elite athletes from different sports: a cross-sectional study. *Am J Sports Med* 2005; 33:561–567.

17. Kettiinen, J.A, M. Kvist, E. Alanen, et al. Long-term prognosis for jumper's knee in male athletes: a prospective follow-up study. *Am. J. Sports Med.* 2002; 30:689-692.

18. Ogon P, Maier D, Jaeger A, Suedkamp NP. Arthroscopic patellar release for the treatment of chronic patellar tendinopathy. *Arthroscopy* 2006; 22:462–465.

19. Ames PR, Longo UG, Denaro V, Maffulli N. Achilles tendon problems: not just an orthopaedic issue. *Disabil Rehabil* 2008; 30:1646–1650.

20. Garau G, Rittweger J, Mallarias P, Longo UG, Maffulli N. Traumatic patellar tendinopathy. *Disabil Rehabil* 2008; 30:1616–1620.

21. Longo UG, Garau G, Denaro V, Maffulli N. Surgical management of tendinopathy of biceps femoris tendon in athletes. *Disabil Rehabil* 2008; 30:1602–1607.

22. Warden SJ, Brukner P. Patellar Tendinopathy *Clin Sports Med* 2003; 22 743–759.

24. Richards DP, Ajemian SV, Wiley JP, Zernicke RF. Knee joint dynamics predict patellar tendinitis in elite volleyball players. *Am J Sports Med* 1996; 24:676–683.

25. Khan KM, Cook JL, Bonar F, et al. Histopathology of common tendinopathies: update and implications for clinical management. *Sports Med.* 1999; 27:393– 408.

26. Fritschy D, Wallensten R. Surgical treatment of patellar tendinitis. *Knee Surg Sports Traumatol Arthrosc.* 1993; 1:131 – 3.

27. Martens M, Wouters P, Burssens A et al. Patellar tendinitis: pathology and results of treatment. *Acta Orthop Scand.* 1982; 53:445–50.

28. Roels J, Martens M, Mulier JC, et al. Patellar tendinitis (jumper's knee). *Am J Sports Med.* 1978; 6:362– 8.

29. Johnson DP, Wakeley CJ, Watt I. Magnetic resonance imaging of patellar tendonitis. *J Bone Joint Surg.* 1996; 78B:452– 7.

30. Cook JL, Khan KM, Maffulli N, et al. Overuse tendinosis, not tendinitis. Part 2: applying the new approach to patellar tendinopathy. *Phys Sportsmed.* 2000; 28:31–46.

31. Alfredson H, Pietila¨ T, Jonsson P, et al. Heavy-load eccentric calf muscle training for the treatment of chronic Achilles tendinosis. *Am J Sports Med.* 1998; 26:360–6.

32. Cook JL, Khan KM, Purdam CR. Conservative treatment of patellar tendinopathy. *Physical Therapy in Sport* 2001; 2:54‑65.

33. Almekinders LC, Temple JD. Etiology, diagnosis, and treatment of tendonitis: an analysis of the literature. *Med Sci Sports Exerc.* 1998; 30:1183– 90.

34. Anastassiades T, Dziewiatkowski D. The effect of cortisone on the metabolism of connective tissues in the rat. *J Lab Clin Med.* 1970; 75:826– 39.

35. Khan KM, Maffulli N, Coleman BD, et al. Patellar tendinopathy: some aspects of basic science and clinical management. *Br J Sports Med.* 1998; 32:346– 55.

36. Rath E, Schwarzkopf R, Richmond JC. Clinical signs and anatomical correlation of patellar tendinitis. *Indian J Orthop.* 2010; 44(4): 435–437.

37. Young MA, Cook JL, Purdam CR, et al. Eccentric decline squat protocol offers superior results at 12 months compared with traditional eccentric protocol for patellar tendinopathy in volleyball players. *Br J Sports Med.* 2005; 39:102–5.

38. Houghton KM. Review for the generalist: evaluation of anterior knee pain. *Pediatric Rheumatol Online J.* 2007; 5:8.

39. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. *Am J Sports Med*; 1982; 10: 150-4

40. Noyes FR, McGinniss GH, Grood ES. The variable functional disability of the anterior cruciate ligament-deficient knee. *Orthop Clin North Am.* 1985; 16: 47-67.

41. Visentini PJ, Khan KM, Cook JL, et al. The VISA score: an index of severity of symptoms in patients with jumper's knee (patellar tendinosis). Victorian Institute of Sport Tendon Study Group. *J Sci Med Sport*. 1998; 1: 22-8.

Appendix

Prescribed Stretches and Strengthening Exercises.

Fig. 6: Rectus Femoris and Iliopsoas Stretch.

Fig. 7: Gastrocnemius Stretch.

Fig. 8: Glute Bridge

Fig. 9: Single Leg Glute Bridge

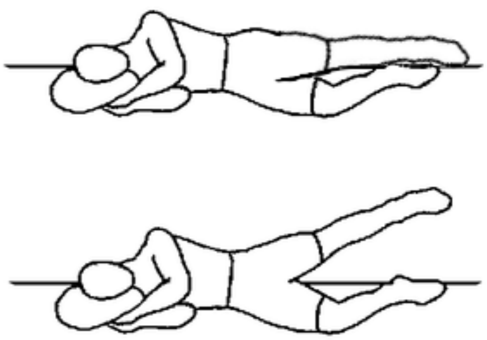

Fig. 10: Side Lying Hip Abduction

Fig. 11: Split Squat

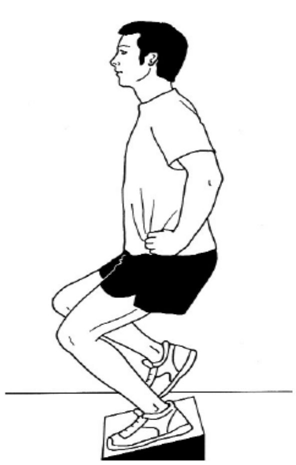

Fig. 12: Decline Squat