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Review Article

Physiotherapy Section

Patellar Tendinopathy: A Review of Literature

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ABSTRACT

Patellar Tendinopathy (PT) is an overuse disorder commonly seen in athletes who participate in jumping and running activities, and it can interfere with their athletic participation. It is characterised by progressive activity-related anterior knee pain and tenderness in the patellar tendon. This study presents an overview of the current knowledge on PT focusing on prevalence, risk factors, symptoms, and management strategies. This review can guide healthcare practitioners in decision making on the management of athletes with this condition.

Keywords: Anterior knee pain, Athletic performance, Jumpers knee, Patellar tendon, Sclerosing injection

INTRODUCTION

Patellar Tendinopathy (PT), also known as jumper's knee, is common in athletes who participate in sports that require jumping and running activities, such as soccer, volleyball, basketball, and tennis, among others. It is characterised by progressive activity related anterior knee pain and tenderness in the patellar tendon. These symptoms may lead to limited activity and reduced sports participation in recreational athletes and impaired performance among professional players that may even impair their athletic career [1]. A survey conducted by Victorian Institute revealed that one third of athletes with PT was unable to continue their training and competition for at least six months despite the treatment strategies applied [2]. Once the symptoms become aggravated, even the activities of daily living, such as stair climbing, squatting, and prolonged sitting, may be affected. Several theories on its pathogenesis have been formulated. Most authors and clinicians support a conservative management, such as modification of training and activities, eccentric exercises, Non Steroidal Anti Inflammatory Drugs (NSAIDS), and stretching. However, if conservative management is not beneficial, a surgical approach should be considered.

PREVALENCE

PT is an overuse injury with a gradual onset of pain. Most athletes with mild or moderate pain continue their practice and competition. As sports injuries are traditionally recorded on the basis of the time loss model (time lost from competition and training), which only records acute injuries and most severe overuse injuries, researchers find it challenging to gather information on the prevalence of PT in the sports population. Studies have examined the prevalence of PT in both athletic and non athletic populations [1,3-6]. It is commonly seen in sports that require a high demand of speed and power for leg extensors, thus causing repetitive stress to the patellar tendon [3]. Lian OB et al., reported an overall prevalence of PT of 14% among elite athletes and that of 45% and 32% in volleyball and basketball players, respectively [1]. PT accounts for 15% of the overall soft tissue injuries among US military recruiters who undergo regular basic training [4]. Cook JL et al., reported a higher prevalence of PT in males than in females, a finding that was not confirmed in a two year follow-up study on 138 college students [5,6]. The higher prevalence of PT among males could be due to the difference in force generation and the ability of athletic movements between males and females [1]. However, the protective role of oestrogen should be further studied.

RISK FACTORS

PT is caused by intrinsic and extrinsic risk factors. One of the most common extrinsic risk factors for PT is training volume and frequency [7]. Training on hard courts and synthetic tracts can increase the risk. However, the use of sprung wooden floors for indoor games has reduced the chance of injury. Reduced shock absorption of sporting shoes and shoe surface interaction are also some of the factors that can trigger the condition.

Intrinsic risk factors: Researchers have reported several intrinsic risk factors for PT, such as height, weight, the length and strength of the hamstring, quadriceps, and calf muscles, the range of motion of the lower extremities, and limb length, among others [5,7-10]. A strong correlation was found between tight hamstring and quadriceps muscles with PT in various studies. Witvrouw E et al., reported greater hamstring and quadriceps muscle flexibility in healthy athletes than in athletes with PT [6]. However, no difference was found between subjects with PT and healthy controls in the study conducted by Crossley KM et al., [11]. Cook JL et al., reported reduced sit and reach in subjects with PT [9]. However, Malliaras P et al., and Gaida J et al., failed to confirm this correlation [12,13]. Malliaras P et al., reported an association between reduced dorsiflexion of the ankle joint and PT [12]. Conversely, Crossley KM et al., did not find any correlation between ankle range of motion and PT [11]. Better knee strength and vertical jump ability were reported in subjects with PT, thus confirming that PT was more prevalent in subjects withbetter jumping ability [7,9,10]. Some investigators reported no association of quadriceps, hamstring, or calf muscle strength with PT [6,11,12]. A high vertical jump test score was found in female subjects with tendinopathy in a study conducted by Cook JL et al., [9]. Crossley KM et al., found no association between hop test performance and tendinopathy [11]. Biomechanical abnormalities, such as pes planus, limb length discrepancy, and patella alta, also increased the risk of development of PT in both athletic and non athletic populations [9,12,13]. Conflicting results were found in numerous studies investigating the association of anthropometric characteristics with PT. Zwerver J et al., reported that athletes with PT would be taller, heavier, and younger than their counterparts without PT [3]. Increased waist circumference was associated with an increased risk of PT, especially among the male population [8]. A larger infra patellar pad was found in subjects with tendinopathy in an ultrasound study [10].

SYMPTOMS

The most common symptom of PT is pain with varying intensities. The pain is usually associated with a change in training pattern or frequency, or with a work overload. The most frequent site of pain is the proximal insertion of the patellar tendon in the lower part of the patella (65%-70%), followed by the quadriceps tendon (20%) and at the insertion of the patellar tendon at the tibial tuberosity (10%). According to the severity of symptoms, Ferretti A et al. classified PT into five stages [14].

Stage 0-No pain.

Stage 1-Mild pain without sports restriction.

Stage 2-Moderate pain during activity without affecting performance.

Stage 3-Pain with slight qualitative and quantitative restrictions in performance.

Stage 4-Pain with severe restriction in performance.

Stage 5-Pain during daily activities.

The most consistent physical finding for PT is the localised tenderness at the patellar tendon. However, Cook JL et al., studied the clinical utility of the palpation of the patellar tendon and concluded that it is moderately sensitive in adolescent athletes diagnosed with PT [15]. The Royal London Hospital test and the palpation test are usually used for making diagnosis. According to Mafulli N et al., both tests should be performed together for the proper clinical diagnosis [16]. The Royal London Hospital test demonstrated a lower sensitivity and higher specificity when compared to palpation test in symptomatic individuals [16]. Single leg decline squat is also used for the functional testing of PT [17]. The test is performed on a 25° decline board. The patient stands on the board with the affected leg and is asked to squat up to 90° while keeping the trunk upright. Several scoring systems for knee injuries and pathologies are available in the literature. However, none of them is successful in detecting the specific inadequacies of athletes with PT [18]. The Victorian Institute of Sport Assessment (VISA) was found to be adequate by different researchers and has been tested for inter and intra tester reliability [19].

IMAGING

Plain X-ray can be used to rule out the associated abnormalities, such as Osgood Schlatter disease or intratendentious calcification. Traditional Ultrasound (US) and Magnetic Resonance Imaging (MRI) are used to determine the tissue pathology of the tendon. The intratendinous lesions appear as zones of lower echogenicity in the ultrasonogram in the posterior aspect of the patellar tendon. Other common findings in the ultrasonogram include intratendinous calcification, thickening of the tendon, irregularity in the para tendon area, and erosion of the inferior pole of the patella [20]. One of the major disadvantages of the US is its inability to rule out intra-articular conditions. The sensitivity and specificity of the US for PT are 58% and 94%, respectively and those for MRI are 78% and 86%, respectively [21]. The MRI can be recommended as the first imaging option for PT because of its greater sensitivity than the US. Another advantage of MRI over the US is its ability to rule out intra-articular conditions. A novel form of US called ultrasound tissue characterisation can help to determine the degree of tissue disorganisation [22].

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of PT includes patellofemoral pain syndrome, Osgood Schlatter disease, patellar tracking issues and subluxation of the patella, pathology of fat pad syndrome, cartilage lesions, and meniscal tears, among others [23].

MANAGEMENT

Although, the pathology of PT cannot be completely resolved, the symptoms can be managed conservatively. Conservative management consists of medical and physical therapies.

NSAIDS are one of the most commonly used medications in the management of PT. Non conclusive evidence available in the literature supports the effect of NSAIDS in the management of chronic PT [24]. The beneficial effects of NSAIDS in acute PT have been reported in some studies [25,26]. However, studies have shown that the prolonged use of NSAIDs may negatively affect the long term healing of the tendon [27]. Several studies reported the potentially favorable effect of NSAIDS on tendon healing, whereas others reported the deleterious mechanism of NSAIDS in the tendon [28,29].

INJECTION THERAPIES

Corticosteroids, Platelet Rich Plasma (PRP), autologous blood, sclerosing substances, and hyperosmolar dextrose are the most commonly used injection therapies in the management of PT. These therapies aim to promote the healing response of the tendon. Sclerosis injection helps to destroy abnormal blood vessels that are commonly seen in PT.

Corticosteroid injection: The use of corticosteroid injection is one of the most debated issues in the management of PT. A number of studies have reported its short-term effect on pain relief, whereas others could not demonstrate any effect. Although corticosteroid injection to the patellar tendon shows some immediate temporary relief, it may affect the tendentious tissue leading to the rupture of the tendon. A randomised control study on 24 athletes who received US guided steroid injection reported a reduction in pain from 2.9 to 1.7 in the numerical rating scale after several days. A steroid induced atrophy of the subcutaneous tissue was observed among nine athletes who received steroid injection [30]. In a six month follow-up study among athletes, the VISA-P scores remained unchanged in the US guided steroid injection group, whereas a good prognosis was reported in the subjects who were treated conservatively [31]. Although corticosteroid injection is not indicated for subjects with degenerative tendinopathy, it can be used as an adjunct to other conservative management methods in conditions without degenerative tendinopathy. However, as PT is not an inflammatory condition and has a negative effect on collagen synthesis and tendon strength, the usage and effect of corticosteroid injection on conditions such as PT has to be reassessed [32]. Fredberg U et al., reported a dramatic clinical effect of steroid injection on PT [30]. They argued that the steroids could revert the pathological changes in the tendon. Kongsgaard M et al., compared the effects of steroid injection, eccentric exercise, and resisted exercise on PT [31]. The study showed a similar positive short-term effect in all the three methods of management, but the effect of steroid deteriorates in the long term follow-up.

Autologous blood injection: James SL et al., performed dry needling in combination with autologous blood injection in subjects with PT [33]. The intervention showed a significant improvement in the VISA-P score, and the patients were able to return to sports. However, the authors recommended further investigation on the effectiveness of autologous blood injection because of the low quality of the research.

Platelet Rich Plasma (PRP): PRP supports tissue repair and regeneration by delivering growth factors and cytokines to the injured area [34]. Although, the PRP injection provides promising results, the rationale behind this treatment method has been questioned by some authors because of the scarcity of well designed studies in this area [35,36]. A follow-up study conducted by Volpi P et al., showed an improvement in the VISA-P score after a single PRP injection in subjects with PT [37]. However, this study had no control group. A six month follow-up study on 20 athletes with PT also showed an improvement in pain score after three PRP injections with a gap of

15 days between injections [38]. The effect of PRP injections is also controversial because of the inconsistency in the method of preparation and the different concentrations of the substances used [39].

Hyperosmolar dextrose: A significant improvement in VAS score was observed in 45 subjects with PT who received US guided hyperosmolar dextrose. The injections were given every six weeks until the symptoms were resolved, and the outcome measurements were taken 45 weeks after the first injection. All of the subjects received an average of four injections with a range of two to eight [40].

Sclerosing injection: A sclerosing injection is usually delivered to the blood vessels just before its entry to the tendons. A sclerosing injection is hypothesised to be capable of destroying the blood vessels and accompanying nerves, thus curing the associated pain [34]. Alfredson H et al., reported a significant decrease in VAS score after six months of sclerosing injection [41]. Conversely, Hoksrud A et al., were not able to confirm this finding in elite jumping athletes [42]. Willberg L et al., demonstrated that arthroscopic shaving is a better treatment option than sclerosing injection in the management of PT [43]. However, further studies on the effectiveness of sclerosing injection on PT are required.

Hyaluronic acid: High molecular weight hyaluronic acid injection therapy can promote tissue regeneration and healing of the tendon. It has been reported to have an anti-inflammatory property as well. Two doses of hyaluronic acid injection were found effective in patients who did not respond to a two month conservative management [44]. Further studies are required to confirm its effectiveness.

The symptoms of PT are usually resolved by appropriate medical and rehabilitative management from a few weeks to six months, and those with PT will be able to return to sports and non limited activities. If the symptoms persist or become worse even after conservative treatment for more than six months, then surgical management can be considered [21].

PHYSICAL THERAPY MANAGEMENT

Although, the pathology of the patellar tendon cannot be resolved completely by conservative management, symptomatic physical therapy has been found effective in most cases. In the initial stages of rehabilitation, the major focus is on pain reduction, followed by strengthening and power exercises and finally functional and return to sports training. The progress of the training can be monitored by a single leg decline squat, which can provide information on the response of the tendon to the exercise program.

Pain reduction: Load management is effective in reducing the symptoms of PT. However, a complete cessation of activities may further reduce the loading capacity of the tendon. Reducing the training frequency and volume and avoiding high load drills, among others, may help to reduce the load of the tendon without the complete cessation of activities. According to Naugle KM et al., a sustained isometric contraction of the tendon is effective in reducing pain [45]. Medication can also help in pain reduction.

Strengthening exercises: Eccentric training is one of the most accepted training methods in the management of PT. It shows good short and long term improvement in the symptoms and VISA-P score. Evidence shows that eccentric training can augment the remodeling of collagen in the patellar tendon [20]. Variable types of eccentric loading are used for the management of PT. Both bilateral weighted squat by a Bosman device and unilateral decline squat were found equally effective in reducing the symptoms in a 12 week prospective study [46]. According to Purdam C et al., the eccentric decline squat (25°) is more effective than the flat single leg squat in reducing the symptoms [47]. Zwerver J et al., and Richards J et al., asserted that a decline squat above a 15° angle is more effective in the management of PT [48,49]. Visnes H et al., performed a critical review of eccentric exercises as a treatment option for PT. The authors concluded that eccentric exercises by using a decline board are more effective and should be performed at certain levels of difficulty [50]. However, they reported a short-term worsening of the symptoms and no overall effect of eccentric training on PT among volleyball players during a competitive season. Athletes undergoing a rehabilitation program, which includes eccentric exercises, should be given adequate rest. Fredberg U et al., also reported an increased risk of injury and a detrimental effect on the tendon when an additional eccentric load was applied in a high load environment (competitive season) [51]. The effectiveness of decline squat was further investigated in a randomised control trial, which showed that the effectiveness of a 12 week decline squat program was at par with the result of an open surgery combined with a well-designed rehabilitation protocol. Larsson ME et al., conducted a systematic review on various methods used in the management of PT [52]. Strong evidence was found for eccentric training as a treatment method for PT. Karlsson J et al., described a conservative management protocol for PT consisting of three phases, namely, acute, rehabilitation, and return to activity [53]. The major component of the rehabilitation and return to activity phasesis the open kinetic chain eccentric exercises of the knee. About 70% of patients reported an excellent outcome of the training program. Cannell L et al., compared the open kinetic chain concentric leg exercise with the drop squat for a period of 12 weeks in PT patients [54]. Both exercise programs were equally effective in reducing the pain and other symptoms. The effectiveness of standard squat training and decline squat training was compared in PT patients [17]. Six out of the eight athletes who trained with the decline squat could return sports, but only one athlete from the standard squat could do so.

Kongsgaard M et al., compared peritendinous corticosteroid injection, eccentric training, and heavy slow resistance exercise in the management of PT [31]. The subjects who received heavy slow resisted exercise showed good short and long term clinical presentation accompanied by the tissue normalisation of the collagen. Malliaras P et al., conducted a systematic review on two or more patterns of exercises in the management of patellar and Achilles tendinitis [55]. They concluded that clinicians should consider a combined approach of both concentric and eccentric loading as an option for management. Silbernagel KG et al., also recommended a combined training program that includes eccentric, concentric, and plyometric training as a treatment portion for PT [56].

Functional strengthening and return to sports: Functional strengthening should primarily address kinetic chain deficits and movement pattern. Once this pattern is improved, athletes should proceed to sports-specific training. The training should include skipping, jumping, agility training, sprinting and plyometrics. It should progress from low intensity to high intensity and high load activity. The major factors determining the prognosis and return to sports activities are severity of pain, pathology, and dysfunction. Gemignani M et al., conducted a sonographic grading of the condition and correlated it with the prognosis and return to sports activities. 20 days of supervised rehabilitation were required to return to sports for mild pathology and 90 days of rehabilitation for severe pathology to return to sports. Aside from the severity of pathology and pain level, athletes with high levels of kinetic dysfunction may take considerable time to return to sports activities [57].

OTHER INTERVENTIONS

Other commonly used interventions that augment exercise programs include myofascial manipulation, bracing and taping, transverse friction massage, pulsed US, and laser, among others. Therapeutic US and cryotherapy are some of the clinical modalities used for tendon pain. However, the literature does not provide much evidence to support these modalities for PT [58]. Stasinopoulos D et al., compared the effectiveness of eccentric exercise, Low Intensity Pulsed Ultrasound (LIPU), and transverse friction massage in PT patients [59]. The researchers reported a better prognosis (both long and short terms) in subjects who had undergone exercise

training. Pulsed US was found to be inferior to eccentric training: none of the patients rated LIPU as successful, 10 out of 10 subjects rated eccentric training as successful. LIPU did not exhibit benefits compared with a placebo in a randomized double-blinded control trial [60]. Another common intervention used for the treatment of PT is bracing or taping. Although, it is commonly used in clinical settings to unload the tendon, limited evidence supports its effectiveness. Myofascial manipulation technique is a recent treatment approach for PT. Pedrelli A et al., reported its positive effect in reducing pain and symptoms immediately and four weeks later in subjects with PT who had undergone a single session of myofascial manipulation technique [61]. However, this study had no control group.

Studies have shown that Extracorporeal Shock Wave Therapy (ESWT) can help in tissue regeneration of the tendon. Three theories have been postulated on the utility of ESWT in various musculoskeletal conditions [62]. According to the first theory, hyperstimulation of the painful area can cause diminished transmission of pain signals to the brain stem. The second theory presumes that ESWT supports tissue regeneration, and the third theory advocates that it can destroy tissue calcification. Van Leeuwen MT et al., conducted a systematic review on the use of ESWT and concluded that it is a safe and promising method of treatment for PT [63]. However, Zwerver J et al., did not find benefits of ESWT for jumping athletes [64]. Wang CJ et al., compared ESWT with other treatment modalities and found that ESWT with physical therapy was far superior to NSAIDs in terms of relieving pain, improving range of motion, and the VISA-P score [65].

An associated hip extensor weakness is commonly observed in PT. Exercise training to strengthen the hip extensor muscles must be incorporated into the PT treatment program [66]. Exercises such as sprinting, jumping, and cutting should also be included in the rehabilitation protocol of PT [67]. Another key component lacking in most rehabilitation programs is the consideration of the kinetic chain [68]. Poor lumbo pelvic control can alter the load distribution and kinetic chain of the lower extremity, thus causing a risk for PT. Proper lumbar stability exercise should be incorporated into the rehabilitation program to improve lumbo pelvic control. However, further research should be conducted in this regard. Well-designed future studies should be made to design a proper protocol for the management of PT. In normal cases, recovery from symptoms, ranging from a few weeks to six months, is possible. If symptoms persist after six months of rehabilitation, then surgical options should be considered.

SURGICAL MANAGEMENT

Although, conservative treatment is successful in most cases, around 10% of patients did not respond to the conservative management and eventually undergo surgery [69]. The literature shows that the success rate of surgical management for PT in chronic case exceeds 80% [21]. Both open and arthroscopic surgeries are commonly performed. Comparing both methods, arthroscopic surgery has faster recovery time; although, the post operative rehabilitation of both surgical techniques is almost the same. Patients usually return to sports activities after three to nine months of supervised rehabilitation.

Open surgery: Open surgical methods include open tenotomy with the removal of abnormal necrotic tissue, resection of the inferior pole of the patella, and removal of abnormal tissue and fat pad detachment from the posterior aspect of the patellar tendon [69]. Bahr R et al., compared the open surgical technique with the eccentric training program in 35 athletes with severe PT [70]. The eccentric training group performed the eccentric decline squat for 12 weeks on a 25° decline board. Extra weight was added during the squat to achieve a pain level of 4-5 in the VAS scale. The surgical group underwent full thickness wedge excision. A well defined rehabilitation program, which included a 25° decline squat from week six onwards, was implemented in the surgical group. However, no extra weight was added during rehabilitation. A 12-month follow-up showed no differences between the groups in the VISA-P scale. The VISA-P score increased from 29±16 to 66±29 in the eccentric group and from 31±15 to 73±20 in the surgical group. A recent systematic review reported a success rate of 87% for open surgical method and 91% for the arthroscopic procedure [71]. The time period required for return to sports activity was 3.9 months for the arthroscopic group and 8.3 months for the open surgery group. The average rate of return to sports was 82.3% and 78.4% after arthroscopy and open surgery, respectively [71]. Although the clinical score was better in patients who had undergone the open procedure with bony patellar resection, the time to return to sports was longer inthose who had undergone the procedure without bony patellar resection. No difference was reported in the rate of return to sports. However, in the case of arthroscopy, the subjects who had undergone resection of the inferior pole of the patella showed a better rate of return to sports than those without resection. The clinical score and the time to return to sports were similar in both groups [71].

Arthroscopy: First described by Romeo and Larson, arthroscopy is a safe and minimally invasive technique for the treatment of PT. It presents reduced post operative pain and knee stiffness, and patients can return to activities faster than those who underwent the open procedure. The arthroscopic procedure includes arthroscopic shaving, release of post paratenon and bony denervation and resectioning of the inferior pole of the patella [21,43,69,72]. Willberg L et al., compared the arthroscopic shaving technique with sclerosing injection in 45 patients in a randomised control trial [43]. No specific rehabilitation protocol was given for both groups, and the patients were advised to progress to full tendon loading after two weeks. A 12 month follow-up confirmed the superiority of arthroscopic shaving in terms of the VAS score. The VAS score improved from 69±17 to 41±29 in the injection group and from 77±14 to 13±19 in the arthroscopic shaving group.

SUMMARY

Patellar tendinitis or jumper's knee is common in jumping athletes and in those who play sports that involves jumping activities. It is a degenerative condition rather than an inflammatory condition. Conservative management consists of eccentric exercises, which give good results. Other treatment options such as ESWT and injection therapies, including PRP and hyaluronic acid injection, also provide promising results. When conservative treatment fails, surgical management is recommended. Although both open and arthroscopic surgeries provide good results, the arthroscopic method is more recommended because it provides faster recovery and faster return to sports activities.

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