Tendinopathies are prevalent among competitive and recreational athletes, which can significantly decrease performance capabilities. Tendinosis is a chronic, degenerative condition that is not associated with an inflammatory tissue response, whereas tendinitis is an acute inflammatory condition. The cause of tendinosis and its associated pain is not completely understood, but it is believed to result from repetitive microtrauma or a failure of the normal healing process after injury. There is a fibroblastic and vascular response associated with tendinosis that is manifested by a proliferation of fibroblasts, vascular hyperplasia, and disorganized collagen. The perception of pain associated with tendinosis could result from a noxious chemical environment.

Due to a lack of understanding about this pathology, the optimal treatment for tendinosis remains unclear. There is some research evidence to support the use of eccentric exercise, which has primarily been focused on the treatment of the Achilles tendon and the patellar tendon. The case we present is unique, because it involved the extensor hallucis longus tendon. This case is also the first one reported to our knowledge that involved administration of manually resisted eccentric exercise. This report presents the case of a female college track athlete who had a 1 1/2-year history of extensor hallucis longus tendinosis.

Case Review

An 18-year-old female college track athlete who competed in jumping and sprinting events reported pain in her left foot that had been steadily getting worse. She reported that she had suffered an injury to her extensor hallucis longus during a jump approximately 18 months earlier. Following the initial injury, the patient did not seek care, ignored the pain, and continued to compete. The pain lessened to a level that was only experienced during activity. She did not participate the following season. We saw her after a break from activity during the preseason period of the following track season, when significant pain had reoccurred. A moderate degree of hallux valgus was evident, but there were no other apparent anatomical abnormalities. Palpation of the dorsum of the left mid-foot elicited pain directly over the extensor hallucis longus tendon. On a pain scale of 1-10, the patient reported a pain level of 2-3 without movement. Pain worsened with active and passive flexion and extension of the great toe to a level of 7-8 out of 10. There was a decreased range of motion and weakness compared to the contralateral side. Radiographs were interpreted as negative. The nature of the injury, its location, the duration of symptoms, and pain with resistance and in response to palpation led to a diagnosis of tendinosis.

Treatment

The athlete was instructed by a physician to use a walking boot for 2 weeks prior to beginning treatment sessions. Over the course of a 6-week period, the patient was treated a total of 18 times. During the first 3 weeks of therapy, the patient reported a progressive reduction of soreness. At the eighth treatment session, the patient experienced soreness only when exercise intensity was increased or new exertion.
cises were introduced. Jogging on a mini-trampoline was initiated during the 3rd week of treatment with no adverse effect. As the patient progressed through the treatment program, additional strengthening and conditioning exercises were introduced that involved adjacent joints. Treatment primarily consisted of manually resisted eccentric exercise, deep transverse friction massage, and pulsed ultrasound.

**Eccentric Exercise**

Manually resisted eccentric exercise was performed during 14 out of the 18 treatment sessions (Table 1). The volume initially consisted of three sets of 30 repetitions, which was progressed to four sets of 15 repetitions, and then to three sets of 15 repetitions at a faster velocity. The exercise was initiated by passively extending the great toe. The patient was then instructed to resist as the great toe was manually pulled into flexion, thereby providing resistance to the eccentric action of the extensor hallucis longus muscle. The patient was asked to resist through a pain level of approximately 5 on a 10-level scale of pain intensity. If the pain worsened, less manual resistance was applied. If pain decreased, increased manual resistance was applied. The exercise program was progressed to include both concentric and eccentric manual resistance after the 11th treatment.

Numerous published reports\(^1,6,7,9-12\) have documented successful recovery from tendinopathies with the administration of eccentric exercise. Eccentric exercise may induce microstructural adaptations within the tendon that enhance its ability to withstand tensile stress.\(^8,9\) Eccentric exercise might also initiate metabolic events that inhibit pain mechanisms.\(^1\) Maximal load is placed on a tendon during the eccentric phase of a functional activity, so it is likely that injury occurs during this phase.\(^9\) A group of patients with Achilles tendinopathy that performed eccentric exercise realized a 50-60% success rate compared to 24% rate for a control group.\(^7\) A reduction in pain has also been reported for patients with patellar tendinosis as a result of eccentric training.\(^12\)

Although research evidence supports the effectiveness of eccentric exercise for the treatment of tendinopathies, a study of eccentric exercise for the treatment of patellar tendinopathy in volleyball players during their competitive season reported no effect.\(^13\) Unlike other studies, the patients were participating in a competitive season. Another possible explanation for the lack of a beneficial therapeutic effect could have been the location of the tendinopathy. Eccentric training seems to yield better results with tendinopathies that affect the mid-portion of tendon, rather than those that affect a tendon insertion.\(^1,13\) Patient compliance may have also been a factor. The athletes were reported to have a tendency to reduce eccentric exercise load during weeks with more than one match or before important matches.\(^15\)

**Deep Transverse Friction Massage**

A transverse friction massage technique introduced by Cyriax\(^14\) was performed at the site of tendon pain for 15 minutes, which was administered during a total of eight treatments (Table 1). The patient experienced pain initially, but it subsided during the treatment process. Transverse friction massage is believed to enhance healing by increasing local blood flow, maintaining or improving mobility,\(^14\) reducing adhesions, and facilitating the realignment of collagen fibers.\(^11\) Friction massage used for the treatment of overuse injuries in athletes has been reported to decrease pain, but the mechanism by which it provides this beneficial effect is not known.\(^5,14\) A study that involved the administration of transverse friction massage to a group of patients with iliotibial band friction syndrome, who also received stretching, cryotherapy, and ultrasound treatments, failed to demonstrate any difference from a group that received only stretching, cryotherapy, and

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**Table 1. Rehabilitation Program**

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The patient whose case is reported received fewer transverse friction massage treatments than eccentric exercise and ultrasound treatments (Table 1). Due to the limited number of transverse friction massage treatments, and the lack of research evidence to support the effectiveness of the treatment, we believe that it probably made relatively little contribution to the patient’s successful recovery.

Ultrasound

Pulsed ultrasound was delivered at a 3 MHz frequency and an intensity of 1.0 W/cm² for durations of 15 minutes, using a small gel disc and coupling gel on the skin surface over the tendon. The 3 MHz frequency was selected because the site of the pathology was relatively superficial. Because absorption of ultrasound energy is greater in protein-rich tissues, which could create a “hot spot” within the tendon, a gel disc was used to create a larger surface area for transmission of the sound waves to the subcutaneous tissues. A pulsed setting was used, which has been shown to have a non-thermal effect that promotes cell proliferation and proteoglycan production in the human nucleus pulposus.

Therapeutic ultrasound has been used to treat surgically repaired animal tendons, but its effectiveness for the treatment of human tendinopathies is inconclusive. A review of studies pertaining to therapeutic ultrasound effectiveness reported that 80% of the studies failed to demonstrate a substantial difference from a placebo treatment. Therapeutic ultrasound has been reported to be no more effective than a placebo treatment for management of chronic lateral epicondylitis and chronic patellar tendinopathy. These studies used protocols that involved daily administration of 20-minute treatments. Our patient received a total of 14 ultrasound treatments on nonconsecutive days (Table 1). We believe that the relative contribution of therapeutic ultrasound treatments to the success of this case was minimal.

Discussion

The best treatment for tendinosis has not been conclusively established, and a combination of treatment techniques is typically used. Tendon pain is often treated with nonsteroidal anti-inflammatory drugs, even though chronic tendinosis is a noninflammatory degenerative condition (i.e., an absence of inflammatory cells within the affected tissue). Overuse or improper management of an acute tendon injury may have led to chronic tendinosis of our patient’s left extensor hallucis longus tendon. The rehabilitation program emphasized manually resisted eccentric exercise, transverse friction massage, and pulsed ultrasound, each of which have been recommended for the treatment of tendinosis.

After approximately a year and a half of intermittent pain, our patient realized a successful recovery over the course of 18 treatments that produced a decrease in pain, increase in strength, and return to full participation in a competitive sport. Eccentric exercise has been reported to be an effective treatment for tendinopathies. Relatively little research evidence currently exists to support transverse friction massage and pulsed ultrasound as effective treatments for tendinopathies. The success of eccentric exercise in this case may be attributed to progressive tendon exposure to tensile loading that induced microstructural adaptations. Maximal tensile load is placed on the tendon during the eccentric phase of a functional activity, so eccentric strengthening seems to be a key factor for the restoration of a tendon tolerance for tensile loading and the prevention of future injury.

To our knowledge, the utilization of manually resisted eccentric exercise for management of tendinosis has not been previously reported. Other reports indicate that eccentric exercises were performed without supervision and that resistance was applied through the use of equipment or against the resistance of body mass. The atypical location of the tendinosis for the reported case suggests that the reported benefit of eccentric exercise for treatment of the condition in the Achilles tendon and the patellar tendon is applicable to other sites.

Summary

A treatment program for tendinosis of the extensor hallucis longus that involved administration of manually resisted eccentric strengthening exercise, pulsed ultrasound, and transverse friction massage was successful for restoration of normal function in a female college track athlete. Although we cannot establish with certainty that the success of the treatment program was solely attributable to the manually resisted eccentric exercise, we believe that it substantially contributed to the successful resolution of the patient’s symptoms. This case demonstrates that eccentric resistance can be effectively administered without the use of equip-
ment. Further research is needed to assess the effectiveness of exclusive reliance on eccentric exercise for treatment of tendinosis in various locations. The treatment outcome realized for the reported case clearly supports eccentric exercise as an effective treatment for tendinosis.

References


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