Comparison of Rehabilitation Methods in the Treatment of Patellar Tendinitis

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Objective: To compare outcomes of 2 rehabilitation protocols on patellar tendinitis subjects.

Design: Prospective, randomized, blinded, controlled clinical trial.

Setting: Outpatient rehabilitation clinic.

Subjects: Randomized into 2 rehabilitation groups—traditional \( n = 10 \) and ASTM AdvantEDGE \( n = 10 \).

Main Outcome Measures: Clinical data and self-reported questionnaires collected at 0, 6, and 12 weeks.

Results: On completion of the 6th week, 100% of the ASTM AdvantEDGE group and 60% of the traditional group had resolved. The unresolved subjects were crossed over to the ASTM AdvantEDGE for additional therapy. At the end of the additional therapy, 50% of the crossover subjects had resolved. The ASTM AdvantEDGE group’s clinical outcomes and weekly journals indicated a statistically significant \( (P = .04) \) improvement in subjective pain and functional-impairment ratings.

Conclusions: Findings suggest that ASTM AdvantEDGE resulted in improved clinical outcomes in treating patellar tendinitis.

Key Words: patellar tendinosis, physical therapy, ASTM AdvantEDGE


With increasing participation in sports and fitness activities, there has been a rise in bone-, joint-, and tendon-overuse injuries. One of the overuse injuries that has become more prevalent is patellar tendinitis, or “jumper’s knee.” Patellar tendinitis is typically an inflammatory condition of the patellar tendon, which originates at the inferior pole of the patella and inserts into the tibial tuberosity, facilitating knee extension. Recent findings have shown this condition to be degenerative in nature. Magnetic resonance imaging has indicated that mucoid degeneration and fibrinoid necrosis can occur, thus causing the failed healing. Khan et al investigated patellar tendons with histopathologic examination and found mucoid degeneration...
in all the tendons of the live subjects, in which case a failed healing response results in prolonged pain and disability, and in 8% of cadavers. There is current debate in the literature regarding the correct terminology.29,10

One of the main causal factors for patellar tendinitis is participation in activities that use the knee-extensor mechanism repeatedly at a submaximal or maximal level of force production concentrically or eccentrically.11,12 Other causal factors that have been identified include quadriceps weakness, patellofemoral joint hypermobility or hypomobility, lower extremity malalignment, poor flexibility, and pain.3,13-15

Tendinitis can occur in different stages. Blazina et al16 proposed a symptomatic classification that divided tendinitis into groups based on signs, symptoms, and level of functional impairment: (1) pain after activity; (2) pain at the beginning of activity, disappearing after warming up and reappearing after completion of activity; (3) pain that remains during and after activity, with the patient being unable to participate in activity; and (4) complete rupture of the tendon. Patients in stages 1–3 are treated conservatively with a decrease or termination of the problematic activity, rest, anti-inflammatory medications, ice, and physical therapy.11,12,17-19 Modalities commonly used for treatment are ultrasound, phonophoresis, iontophoresis, electrical stimulation, and cross-friction massage.1,3,13,14 Stage 4 is treated with surgery.4 Colosimo18 states that there are no reports of the rationale for surgery, but, presumably, excision of the degenerative, painful tissue is intended to promote healing. Torstensen1 found no clinical significance and little experimental evidence to show that treatment in any of the stages, whether conservative or surgical, does in fact cause any significant improvement.

Currently, traditional treatment methods for patellar tendinitis include rest, medication, ice, and physical therapy.11,17-19 Common modalities used in physical therapy are ultrasound, phonophoresis, electric stimulation, cross-friction, and stretching and strengthening exercises.1,3,13,14 Presently, it does not appear that clinicians follow a standardized protocol in treating patellar tendinitis.

We have observed clinical success in treating patellar tendinitis and other chronic tendinitis or tendinosis with an advanced form of soft-tissue mobilization known as ASTM AdvantEDGE. ASTM AdvantEDGE is a process that employs specially designed instruments to help the clinician mobilize soft-tissue fibrosis.20-24 The instruments are handheld devices with an angled edge, which are guided in a stroking motion along the skin. These instruments help the clinician detect changes in the soft tissue’s texture and institute a controlled microtrauma to facilitate an inflammatory response and healing cascade. Research performed on collagenase-injected rat Achilles tendons by Davidson et al21 suggested that ASTM AdvantEDGE stimulates a fibroblast response and the potential for enhanced healing. Gehlsen et al22 found that the fibroblast response varied based on the pressure applied during treatment. Several case studies noting the ASTM
AdvantEDGE’s clinical effectiveness have been published.\textsuperscript{20,21,24} An unpublished study, similar to ours, analyzed the outcome of patients with lateral epicondylitis who were treated with the ASTM AdvantEDGE process versus phonophoresis and cross-friction massage. That study found an 82% success rate for ASTM AdvantEDGE, compared with 39% for phonophoresis and cross-friction. Our study followed the lateral epicondylitis study to evaluate the effectiveness of ASTM AdvantEDGE in a lower extremity overuse syndrome.

The purpose of this study was to compare the outcomes of 2 rehabilitation protocols in the treatment of patellar tendinitis. Clinical data and self-reported questionnaires capturing pain and impairment ratings were collected to determine which treatment was more effective in reducing pain and improving function.

Methods

Subjects

A physician, fellowship-trained in sports medicine, evaluated 38 subjects. The diagnosis of patellar tendinitis was based on clinical history and physical examination. The inclusion criterion was physician diagnosis of patellar tendinitis. Exclusion criteria for participation included open lesions in the area of treatment, anticoagulant therapy such as warfarin (coumadin) or heparin, known coagulation disorders, and any previous knee surgery or internal knee pathology. Three-view knee X rays were taken to exclude bony abnormality.

Once the subjects met inclusion criteria, they were individually randomly assigned to either the traditional or the ASTM AdvantEDGE group at an outpatient rehabilitation clinic. Four clinicians treated both groups, 2 per group. Outcome data were collected through the weekly journals, with subjects tracking their perceived progress and comparing it with the physician’s examination. The stretching and strengthening program was implemented to maintain flexibility and reestablish muscular balance around the area that was being treated, as well as to influence the structural alignment of the remodeling collagen fibers and soft-tissue matrix. All the strengthening exercises were performed and progressed based on each subject’s pain tolerance.

Initially, 38 subjects enrolled in the study, but 18 were dropped after randomization. The dropped subjects did not comply either with physician visits or with the rehabilitation protocol. Of the remaining 20 subjects, 12 men and 8 women were randomized as follows: traditional ($n = 10$) and ASTM AdvantEDGE ($n = 10$). Table 1 depicts subject characteristics for each group.

Traditional Group. The traditional group received rehabilitation 3 times a week for 4 weeks. The subjects performed an active warm-up on a
Table 1  Physical Characteristics of Subjects’ Mean and Standard Deviation Values

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Subjects</th>
<th>Mean Age (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Men 6, Women 4</td>
<td>28.6 ± 2.94</td>
</tr>
<tr>
<td>ASTM AdvantEDGE</td>
<td>Men 5, Women 5</td>
<td>30.4 ± 2.53</td>
</tr>
</tbody>
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stationary bicycle, the stretching protocol, and then received cross-friction massage over the patellar tendon for 5 min. At the clinician’s discretion, subjects could also receive additional modalities such as ultrasound, phonophoresis, or electric stimulation, because of the fact that there are no known standard modalities or protocols for the treatment of patellar tendinitis that have proven to have a clear benefit. After the subjects received the modality part of the protocol, they once again performed the stretches, followed by the strengthening exercises and again by the stretches, then finally cryotherapy.

**ASTM AdvantEDGE Group.** The ASTM AdvantEDGE group received the same rehabilitation therapy protocol, but using ASTM AdvantEDGE instead of cross-friction massage and other modalities, 2 times a week for 4 weeks. ASTM AdvantEDGE involves using instruments (Performance Dynamics, Muncie, Ind) that augment a clinician’s ability to perform this type of soft-tissue mobilization. The instruments are specially designed, handheld devices with an angled edge that are guided in a stroking motion along the skin (Figure 1). A lubricant is applied before treatment to reduce the coefficient of friction and prevent abrasive trauma to the underlying skin during the treatment. The instruments are moved via primarily longitudinal strokes along the musculotendinous structures and are used in multidirectional strokes around the bony prominences of the joint. During each treatment session, the clinician goes through a progression of instruments, from those with a larger area of contact to those with progressively smaller areas of contact. As an instrument moves over the skin, the clinician and subject can detect changes in the soft-tissue texture through the reverberation of the instrument as it contacts the underlying tissue. The instruments are made of a specially formulated polyurethane material that gives them a resonant capacity. Thus, connective-tissue irregularities can be detected by the clinician in the form of an increased vibration. The pressure applied is firm enough to locate areas of change, presumably fibrosis, and to “catch” on those areas to induce microtrauma and trigger a localized inflammatory response.

The subjects were treated in the outlined manner while in a seated position. This allowed the clinician to address the extensor mechanism of the
knee, including the quadriceps muscle belly, the quadriceps tendon, peri-patellar structures, and, especially, the patellar tendon.

**Procedure**

Each subject was evaluated by a physician and asked to complete the questionnaire initially and after 6 and 12 weeks. At the evaluation, clinical data were collected, such as noted swelling and location of pain and tenderness. The physicians were blinded to the treatment-group randomization. All subjects received the same instructions by a clinician on the following: (1) stretches—hamstring, quadriceps, IT band, gastrocnemius, and soleus 2 times a day, holding for 30 seconds; (2) strengthening—a progression of quad sets, straight-leg raises, standing Theraband (hip flexion, extension, abduction, and adduction), heel raises, step-ups, leg press, squats, lunges, and stair climber, all progressed based on patient tolerance; (3) ice massage—10–20 min, 3–5 times daily; and (4) a weekly progress journal. The 6-week follow-up was to ensure that the subjects had completed 4 weeks of therapy and included physical evaluation for clinical improvement and validation of compliance. Each subject who met resolution criteria would return in another 6 weeks for the final testing session and physician visit. If a subject did not resolve, the physician became unblinded and crossed the subject over to the opposing treatment group for an additional 4 weeks of therapy. Successful resolution criteria, determined only at the end of 6 weeks, consisted of no swelling, no pain on palpation, and the ability to do the following with minimal pain (less than 3 of 10): 6 single-leg hops, squat to thigh parallel, and eccentric-load step-down (step with unaffected leg off of stepping stool 10 in high). The 12-week final visit was for physical evaluation on clinical improvement and to ensure collection of the weekly journals.
Questionnaires

The Patellofemoral Joint Evaluation Scale was used at initial evaluation and the 6-week follow-up to determine knee daily function. The maximum scale value was 100 points, based on questions about the following: limp, assistive devices, stair climbing, crepitation, instability, swelling, and pain. Perceived pain rating was also evaluated by using the Patellofemoral Joint Evaluation Scale pretreatment and at the 6-week follow-up. The Blazina Scale was recorded to determine the stage of tendinitis for descriptive purposes, which were defined earlier.

Functional Outcome

The weekly progress journals were used to track compliance and measure activity, pain at rest and with activity, and impairment. Impairment was evaluated by using the weekly progress journal pretreatment and at the 6-week follow-up.

Statistical Analysis

After the descriptive statistics were completed, inferential statistical procedures were employed. A 2-way repeated-measures analysis of variance (ANOVA) was used to determine significant differences between and within sessions and groups for perceived pain and impairment. Chi-square analysis was used to determine significant differences between perceived pain ratings between and within sessions and groups. The 12th-week data are reported on observational basis only. The alpha level was set at $P < .05$ before data collection.

Results

Whereas 60% ($n = 6$) of the traditional group resolved, the entire ($n = 10$) ASTM AdvantEDGE group resolved. The remaining 40% ($n = 4$) of the traditional group crossed over to the ASTM AdvantEDGE protocol for additional therapy. At the end of the additional therapy, 50% ($n = 2$) successfully resolved, leaving 2 subjects who did not resolve with either intervention.

Questionnaires

Both groups improved their scores on the Patellofemoral Joint Evaluation Scale and the Blazina Scale, but no statistically significant differences between the treatment groups were noted. Initially, on the Patellofemoral Joint Evaluation Scale, the traditional group scored an average of 61 (ranging from 28 to 71), and the ASTM AdvantEDGE group scored an average of 74
(ranging from 61 to 88). On completion of the sixth week, the traditional group scored an average of 89 (range 73–100), and the ASTM AdvantEDGE group scored 85 (range 63–95). On completing the study, the traditional group scored an average of 90 (range 76–100), and the ASTM AdvantEDGE group scored an average of 91 (range 75–100). Initially, with the Blazina Scale, the traditional group rated 2.4 and the ASTM AdvantEDGE group rated 2.0. On completion of the sixth week, the traditional group rated 2.4 and the ASTM AdvantEDGE group rated 1.1. At the end of the study, both the traditional group and the ASTM AdvantEDGE group ranked 1.0. However, the group that crossed over from traditional to ASTM AdvantEDGE rated 2.3.

**Functional Outcome**

Based on the weekly progress journals, both groups were equal in terms of compliance to exercise. However, the ASTM AdvantEDGE group exhibited a positive trend in being more active. A repeated-measures ANOVA indicated a statistically significant difference \( P < .05 \) for the ASTM AdvantEDGE group in percentage of improvement with pain during and after activity, as well as percentage of improvement on the impairment scale among all 3 sessions. An ANOVA for the traditional group indicated a statistically significant difference \( P = .05 \) in percentage of improvement on the impairment scale between the initial and sixth-week visits. No other significant difference was found for the traditional group.

Throughout the testing periods, there were no improvements in pain during or after activity for the traditional group; however, they did exhibit a significant difference \( P = .05 \) in percentage of improvement on the impairment scale. There was a significant difference for the ASTM AdvantEDGE group in all 3 categories. The ASTM AdvantEDGE group presented a statistically significant difference \( P = .04 \) for all 3 testing periods: initial to 5, initial to 12, and 6–12 weeks. The percentage of improvement was significantly greater \( P = .04 \) for the ASTM AdvantEDGE group than for the traditional group.

**Discussion**

This study attempted to determine the therapeutic outcome in the treatment of patellar tendinitis. The data indicate that the ASTM AdvantEDGE group appeared to achieve equal or better outcomes. These findings were prevalent in the resolution rates and weekly home progress journals and confirmed by the blinded-physician clinical evaluation.

Patellar tendinitis has traditionally been diagnosed based on a history of repetitive activity, localized pain, and point tenderness on palpation of the patellar tendon from the insertion at the inferior patellar pole to the
tibial tubercle. In a study by Ferretti et al, 71 of 109 cases of patellar tendinitis were localized at the inferior pole of the patella. This study confirmed those findings, with 80% of subjects experiencing pain at the inferior pole. According to Eifert-Mangine et al, histological studies indicate that inflammation and chronic injury are usually localized at the bone-tendon junction. When repetitive stresses such as jumping overcome a tendon's strength, microscopic tears occur, and in a chronic scenario, these might be replaced with scar tissue.

In the present study, there are potential confounding variables. We did not use imaging studies (ie, ultrasound or magnetic resonance imaging) to determine the amount of tendinopathy. X rays were taken to rule out bony abnormalities, but they cannot detect tendon changes. The main reasons that no further imaging studies were conducted was the cost and the lack of availability of the procedures and technology. Therefore, because no imaging studies were done, the subjects were clinically diagnosed with patellar tendinitis.

Another potential confounding variable was the choice of the traditional treatment protocol for patellar tendinitis. Because of difficulty in standardizing a traditional treatment protocol, the clinicians were given discretion in using ultrasound, iontophoresis, and/or electric stimulation. It was our intention to provide the clinicians with the "real world" indecision of therapy protocol, because no standard protocols were available. It is possible that the incorporation of other modalities not included in this study could have improved the outcome of the traditional group.

Other potential confounding variables include the number of treatments each group received and the low number of subjects that completed the study. The traditional group received 3 treatment sessions a week for 4 weeks (12 sessions), whereas the ASTM AdvantEDGE group only received treatment 2 times a week for 4 weeks (8 sessions). The discrepancy is a result of the nature of the ASTM AdvantEDGE treatment process and the need to allow the body to heal between sessions. The traditional group received the standard or normal number of sessions per week. We also used every measure to try to ensure subjects' compliance in order to complete the study, but, nonetheless, 48% did not complete it.

Our goal is to perform a larger clinical trial with more subjects, which would confirm the results of this study, and use a monetary incentive to increase compliance. It would also be valuable to include measurable functional tests that could document change in performance over time or as the result of a particular treatment. Single-leg squats measuring the reach or excursion of the contralateral limb, as outlined by Gary Gray in Lower Extremity Functional Profile, would be an excellent addition. Single-leg hop for distance or 10-m single-leg hop for time as outlined by Dr. Frank Noyes in the Noyes Knee Rating System would help further measure improvement in functional performance.
ASTM AdvantEDGE has been previously investigated in animal research and case studies. In a study by Davidson et al., ASTM AdvantEDGE was used to introduce a controlled amount of microtrauma into enzyme-induced injured rat Achilles tendons. This controlled injury caused a small amount of microvascular trauma and hemorrhage that induced a localized inflammatory response. In Davidson’s study, light microscopy demonstrated increased fibroblast proliferation in the tendinitis–plus–ASTM AdvantEDGE group. They concluded that although healing in rats might not translate directly to humans, their findings suggest that ASTM AdvantEDGE can promote healing via increased fibroblast recruitment. In a study by Gehlsen et al. examining the effect of pressure on rat Achilles tendons, the researchers concluded that with greater pressure there was an increase in fibroblast recruitment. In a study by Melham et al. examining an athlete with chronic ankle pain and fibrosis, the authors concluded that ASTM AdvantEDGE might provide an effective treatment option for connective-tissue fibrosis. In another case by Henry et al. investigating ASTM AdvantEDGE in the treatment of a patient with bilateral total knee replacement, the authors concluded that ASTM AdvantEDGE appeared to reduce impairment associated with limited range of motion secondary to soft-tissue restrictions. All of the ASTM AdvantEDGE case studies have been conducted with identical ASTM AdvantEDGE protocols. The protocols for the animal research study were modified to adjust to the rat Achilles tendon.

**Conclusion**

ASTM AdvantEDGE is a process developed to efficiently mobilize and stimulate the resorption of soft-tissue fibrosis thought to be the underlying cause in many joint and connective-tissue dysfunctions. This study demonstrated that the ASTM AdvantEDGE shows promise as a means of resolving difficult and persistent clinical problems. In view of the relief of symptoms in most subjects, ASTM AdvantEDGE appears to be a viable treatment for patellar tendinitis.

This study suggests that using ASTM AdvantEDGE results in improved clinical and functional outcomes with a decreased number of therapy sessions. The ASTM AdvantEDGE group had decreased impairment resulting from pain during activity, as well as increased function. Several treatment modalities are available for clinicians to treat musculoskeletal problems. ASTM AdvantEDGE was used successfully to treat patellar tendinitis and might provide an effective treatment option for the conservative management of patellar tendinitis.

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References


