Muscle Energy Technique Compared to Eccentric Loading Exercise in the Management of Achilles Tendinitis: A Pilot Randomized Controlled Trial

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Abstract

Background: Achilles tendinitis is a common overuse injury among both elite and recreational athletes involved in activities such as repetitive jumping and running. Aim: The aim of this single-blinded randomized study was to compare the efficacy of muscle energy technique (MET) and eccentric loading exercise (ELE) interventions on improving functional ability and pain reduction among athletes with Achilles tendinitis. Methods: A single-blinded, pilot, randomized study was conducted in the Department of Physical Therapy, Global Hospitals and Health City, India, with 6-week follow-up. A total of 30 patients with Achilles tendinitis were randomly allocated to receive either MET (n = 15) or ELE (n = 15) treatment. Treatment effects were evaluated by pre- and post-treatment assessment of visual analog scale (VAS) and Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire. Measures were performed by single-blinded evaluators at baseline and at 2, 4, and after 6 weeks of treatment. Results: Both groups showed a significant difference in VAS after 6 weeks’ ELE group showed a significant improvement during treatment at 2 and 4 weeks in comparison with MET group. The VISA-A scale score significantly improved in both groups. Yet, comparison of VISA scores between groups showed marginally significant difference (P = 0.012). Conclusion: This pilot randomized controlled trial (RCT) showed the efficacy of ELE in reducing pain and improving functional ability among patients with Achilles tendinitis. The findings of this study provide the rationale for undertaking a large-scale RCT. A large sized trial is needed to establish evidence for clinical practice of ELE in Achilles tendinitis cases.

Keywords: Achilles tendinitis, eccentric loading exercise, muscle energy technique

Introduction

It has been estimated that 30%-50% of all sports injuries are so-called overuse injuries.[1-3] It has also been estimated that chronic tendon injuries account for approximately 50% of occupational illnesses.[4,5] The Achilles tendon commonly gets injured in athletes involved in running and jumping.[6-13] Rolf and Movin have found that about one-third of patients with Achilles tendinitis do not participate in vigorous physical activity.[14] Achilles tendinitis causes many patients to significantly reduce their physical activity level, with a potentially negative impact on their overall health and general well-being.[6,15,16] Proximal portion of Achilles tendon is musculotendinous, midportion of Achilles is purely tendinous, and distal portion comprises osseotendinous junction.[17] Achilles tendon receives its blood supply from paratenon, myotendinous, and osteotendinous junction. Midportion of Achilles has a lower vascular supply compared to the rest of the tendon. Hence, injury to midportion of Achilles has a likelihood of delay in healing.[6] Langberg et al. have shown that exercise increases the circulation in the tendon by 2.5-3.5 times the resting rates in patients, independent of age.[18,19] The research performed on blood flow indicates that tendon tissue is very much a dynamic tissue which responds to muscular activity.[20] The maturation and remodeling phase of

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tendon healing is reported to occur from 3 weeks to 12 months after tendon rupture.\textsuperscript{[6,14,21,22]} Hence, therefore, a patient with an injury to the Achilles tendon therefore expects a recovery time of 3 months to a year, and sometimes longer, depending on the severity of the injury.

Experienced clinicians begin conservative line of rehabilitation for Achilles tendinitis by identifying and correcting possible etiologies. Despite various treatment recommendations described in literature, only a few randomized treatment trials are available. Stanish et al. introduced the concept of eccentric training in the rehabilitation of tendon injuries in the mid-1980s.\textsuperscript{[23,24]} Stanish also recommends that patients should perform the eccentric exercises with no pain while Scandinavian authors recommend pushing through pain.\textsuperscript{[11,24,25]} Roos et al. (2004) and Silbernagel et al. (2001) support graded eccentric exercise regimen in Achilles tendinitis.\textsuperscript{[26,27]}

Several manual techniques are involved in the rehabilitation of tendinitis, among which muscle energy technique (MET) plays a key role. MET and its effect on tendinitis is reported in literature. Extensive search of trials and reviews by the authors to compare effectiveness of MET and eccentric loading exercises (ELEs) resulted in low-level evidence due bias or limited methodologies. Therefore, we conducted a single-blinded pilot randomized controlled trial (RCT) to compare the efficacy of MET and ELE in reducing pain and to improve functional ability among patients with Achilles tendinitis.

**Methods**

The local Institutional Review Board approved the study and a detailed explanation of the study was given to each patient and written consent was obtained. A total of 55 patients with Achilles tendinitis attending Outpatient Department of Physical Therapy in Global Hospitals and Health city during the period December 2014–March 2015 participated in this pilot randomized study. Patients fulfilling the predefined study protocol entry criteria were randomized into two treatment groups – MET Group (I) and ELE Group (II) to receive 6 weeks of rehabilitation program [Figure 1]. Patients that did not fulfill eligibility criteria or unwilling to participate were treated by standard procedures. Out of 55, only 30 patients were eligible to participate in this study.

A computer-generated 1:1 randomization scheme was prepared by administrative personnel. The random list was not known to anyone involved directly in the study. A concealed opaque identical envelope (thirty envelopes) with specific group name, MET (I) or ELE (II), was prepared by hospital receptionist and the patients were asked to select any one of those concealed envelopes. The patients presented the envelope to the treating physical therapist at the start of treatment, and then, the patients are allocated in their treatment group. The principal investigators (HR and BJ), who were blinded to group allocation, performed baseline evaluation consisting of VAS, Victorian Institute of Sports Assessment-Achilles (VISA-A), and follow-up outcome measures at 2, 4, and 6 weeks.

The inclusion criteria were male and female patients aged between 18 and 40 years, diagnosis of Achilles tendinitis based on standard clinical diagnostic criteria as assessed by experienced physiatrists and physical therapists, tendon pain localized at 2–7 cm from distal insertion, and patients who had not received treatment within the last 1 month. The exclusion criteria were patients undergoing physical therapy, patients taking medications, additional ankle and foot conditions, or any other illness or injury thought to interfere with the participation in the study.
Outcome measures
Outcomes were measured before the commencement of treatment, after 2 weeks, after 4 weeks, and after 6 weeks of treatment. The primary outcome measures were the Swedish version of the VISA-A questionnaire specifically designed for Achilles tendon problems, which is scored on a scale from 0 to 100 (100 - a totally healthy tendon and 0 - a painful tendon severely impacting function). For pain level documentation, visual analog scale (VAS) was used, where 0 is equal to no pain and 10 is the worst pain imaginable. The pain experienced by the patient, first thing in the morning was told to be marked.

Muscle energy technique protocol
Patients were instructed about the treatment procedures of MET. The treating physical therapists were trained to do post-isometric relaxation technique for gastrosoleus muscle. (not more than 20% of available strength) offered from right thumb (movement resisted against plantar flexion). This contraction is held for up to 20 s. On slow release, the ankle is dorsiflexed, slightly and painlessly beyond the new barrier. The pattern is repeated until no further gain is achieved (backing off the midrange for the next contraction). The direction and dosage of MET procedure were tailored based on the pain feedback from patients. The patients were treated for 60 min every day for 5 days in a week, for 6 weeks.

Eccentric loading exercise
Patients were instructed to stand with forefeet (ball of toes) on the edge of a step with the heels raised and the knees straight. Patients were then instructed to take the unaffected leg off the step and slowly lower the affected heel as far as they can and hold this position for 10 s; Place the unaffected leg back onto the step; Use the unaffected leg to help raise the body back up to the starting position and hold this position for 10 s. This eccentric exercise is repeated for up to three sets of 15 repetitions. A rest period of 1 min was given in between each set. The exercises were performed once a day, 5 days in a week, and for 6 weeks.

Compliance
All patients in both groups kept a training diary for 0–6 weeks. Patients documented their exercises, other physical activities, and changes in symptoms or other comments. The training diary was used by the treating physical therapist to assess compliance of treatment groups.

Statistical analysis
Statistical analysis was performed using Statistical Package for Social Sciences software SPSS 20 (IBM Armonk, NY, United States of America). All thirty recruited patients completed the course of treatment as described in the methodology according to the group allocation and were therefore eligible to be included in analysis. In both groups, baseline measurements and primary outcomes were compared using Student’s t-test to analyze the homogeneity between the groups. Repeated-measures ANOVA (within-patient effect) was used to compare repeated measures of outcome scores for Group I and II. To compare the between-group effect, repeated-measures ANOVA between-patient effect was performed.

Results
Demographics
In all, 55 patients were screened, and 25 patients were excluded from the study. A total of thirty patients met inclusion criteria and participated actively in the study for 6 weeks. In this study, all thirty patients had unilateral condition. At baseline, there were no differences in patient characteristics between the groups [Table 1]. The mean (range) age was 29 (21–40) years, mean duration of symptoms was 2 (0.67–4.3) months, mean body mass index was 26.8 (20.1–31.4) kg/m², ten patients were elite athletes, and twenty were recreational or leisurely involved in sports activities.

Visual analog scale
VAS had a significance of $P = 0.32$ at 2 weeks, 1.00 at 4 weeks, and 0.001 at 6 weeks in MET group, which is suggestive of gradual reduction of pain through the course of training. However, in ELE group, VAS score attained a significant $P = 0.001$ at 2 weeks, 4 weeks, and at the end of 6 weeks, which shows a significant reduction of pain at initial phase of the training and continued till 6 weeks. Mean ± SD of MET group at baseline, 2, 4, and 6 weeks was 5.20 ± 0.77, 4.8 ± 0.77, 4.53 ± 0.64, and 2.67 ± 0.96. Mean and SD of ELE group at baseline, 2, 4, and 6 weeks were 5.33 ± 0.72, 4.13 ± 0.52, 2.73 ± 0.80, and 0.93 ± 0.96. There was a statistically significant difference (<0.001) the both groups with ELE training group showing more improvement in pain reduction [Table 2]. Between-group comparison of VAS showed a significant difference $P = 0.001$ [Table 3].

Victorian Institute of Sports Assessment-Achilles
Significance of VISA-A in both groups was 0.001 at 2, 4, and 6 weeks showing initial improvement of VISA-A score [Table 2]. Between-group comparison of t-value for VISA-A was 0.012 [Table 3]. VISA-A score of MET group at baseline, 2, 4, and 6 weeks was 24.01 ± 3.55, 28.73 ± 3.97, 39.00 ± 3.70, and 59.00 ± 2.75, respectively, showing an increase of 34% after 6 weeks, compared with baseline. In ELE group, VISA-A score increased 50% after 6 weeks, compared with baseline.

Discussion
This prospective, randomized controlled study compared the effectiveness of MET with that of eccentric exercise program in treating Achilles tendinitis. The significant outcomes in the ELE group were progressively higher than MET group. Our results regarding eccentric exercise are similar to those reported by many other authors,[11,21,22] showing that eccentric exercise is effective in the management of tendinitis. Biomechanical and anatomical studies on eccentric exercises have enhanced our understanding of its mechanics with implications for the management and rehabilitation of
Table 2: Within groups analysis of visual analog scale and Victorian Institute of Sports Assessment - Achilles

| Within group | MET Group | Mean±SD | P  | ELE Group | Mean±SD | P  |
|--------------|-----------|---------|----|-----------|---------|----|
| VAS          | Baseline  | 5.2±0.77|     | Baseline  | 5.3±0.72| 0.001*|
|              | After 2 weeks | 4.8±0.77| 0.32|           |         |     |
|              | After 4 weeks | 4.5±0.64| 1.00|           |         |     |
|              | After 6 weeks | 2.7±0.96| 0.001* | After 2 weeks | 31.47±7.1 |     |
|              | After 4 weeks | 39.0±3.7 |     | After 6 weeks | 44.67±6.5 |     |
|              | After 6 weeks | 59.0±2.7 |     | Baseline | 26.13±5.7 |     |

*Significance of P<0.001. VAS=Visual analog scale, SD=Standard deviation, MET=Muscle energy technique, ELE=Eccentric loading exercise, VISA-A=Victorian Institute of Sports Assessment-Achilles

Table 3: Between group mean differences for visual analog scale and Victorian Institute of Sports Assessment-Achilles

| VAS          | Mean±SD | Significance | | VISA-A | Mean±SD | Significance |
|--------------|---------|--------------| |---------|---------|--------------|
| MET          | ELE     |              | | MET     | ELE     |              |
| Baseline     | 5.2±0.77| 5.3±0.7 | 0.001* | Baseline | 24.01±3.55| 26.13±5.68| 0.012* |
| After 2 weeks | 4.8±0.77| 4.1±0.52 |     | After 2 weeks | 28.73±3.9 | 31.47±7.12 |     |
| After 4 weeks | 4.5±0.64| 2.7±0.80 |     | After 4 weeks | 39.00±3.7 | 44.67±6.51 |     |
| After 6 weeks | 2.6±0.96| 0.9±0.96 |     | After 6 weeks | 59.00±2.7 | 66.47±7.95 |     |

*Significance of P<0.001. VISA-A=Victorian Institute of Sports Assessment-Achilles, SD=Standard deviation

Achilles tendinitis. Eccentric exercise reshapes and enhances the tolerability of Achilles tendon by strengthening the fiber cross-link in the tendon.[32] Eccentric exercises alter tendon pathology in both the short term and the long term. Tardioli et al. studied short-term effects of eccentric exercise on Achilles tendon by MRI analysis and reported that a single bout of exercise increased the tendon volume and signal intensity.[19,29] It has been proposed that eccentric exercise promotes Type I collagen production, leading to improved tensile strength.[30] Further, repetitive stretching producing a “lengthening” of the muscle–tendon unit might also enhance the capacity of musculotendinous unit to absorb mechanical load. The unique feature of Alfredson’s eccentric training program is that the patient performs heel drop exercises that are painful.[11-13] The number of ELE repetition promotes neovascularization in the dense tendinosis tissue.[32]

The beneficial effect eccentric loading in Achilles tendinitis might be attributable to the effect of stretching resulting in lengthening of the muscle–tendon unit and lesser strain during ankle joint motion as well as hypertrophy and increased tensile strength of the tendon.[33] Measurements using microdialysis in the human Achilles tendon showed that an acute effect by increase in type I collagen and vascularity in paratendinous region. According to Chaitow, MET is an active muscular relaxation method, normal blood circulation is restored which wipes out nociceptive stimulants from the site of pain which relieves pain.[14] In recent years, several researchers have examined the effects of MET in many musculoskeletal disorders. Harirarasudhan and Balamurugan[35] examined the outcomes of MET in patients with low back pain, and they concluded that the MET group showed greater improvement in Oswestry disability index. Selkow et al.[36] investigated the short-term effects of MET on pain in individuals with nonspecific lumbopelvic pain and demonstrated a significant improvement in VAS. Moore et al. revealed immediate improvements in both the glenohumeral joint adduction and internal rotation ROM in asymptomatic patients. Statistically, our study results indicate that the management of Achilles tendinitis with ELE is effective when compared to MET. MET could used as a second-line therapy along with ELE. Thus, our study results suggest that eccentric exercise is more effective than MET in improving functional outcomes.

Conclusion

This pilot study shows that ELE is potentially effective in the rehabilitation of Achilles tendinitis. ELE reduced pain and improved functional outcome in patients with Achilles tendinitis. Eccentric exercise training resulted in functional outcome improvement and pain reduction at the initial phase of training which MET failed to do. Hence, the results of eccentric exercise in this study are more promising than previously reported. Our next step is, therefore, to confirm this effect in an adequately powered RCT.

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Conflicts of interest
There are no conflicts of interest.

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