Effectiveness of Eccentric Exercise Training on Chronic Achilles Tendinopathy in Postmenopausal Women

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ABSTRACT

Background: In the Postmenopausal phase, there is a drastic reduction in estrogen levels which may alter tendon metabolism and production of different growth factors, resulting in chronic tendon disorders or tendon rupture. Achilles tendinopathy predominantly affects athletes, but it may also impact individuals with sedentary lifestyles, especially women in their postmenopausal stage. We studied the effectiveness of eccentric exercise training on chronic Achilles tendinopathy in postmenopausal women.

Methods: 31 females (aged 45-60, average age 51, BMI 27.6 ± 4.7, range 22.9- 32.3) in their postmenopausal phase with clinical diagnosis of chronic unilateral Achilles tendinopathy both insertional and mid-portion were assessed for pain and functional outcomes with VAS (on rest and on activity ) and VISA-A questionnaire before commencing the exercise and after completion of the training after a duration of 4 weeks.

Results: Participants showed an acute improvement in pain on rest and activity and the VISA-A score post-intervention. There was no significant difference in the pre- and post-score on the VAS scale and the VISA-Questionnaire. The mean VAS scale score on rest was 3.580 pre-intervention and 2.903 post-intervention, while the VAS scale score (on activity) was 7.451 pre-intervention which reduced to 6.096 post-intervention. The mean VISA-A score pre-intervention was 39.80, and post-intervention was 46.35.

Conclusion: Postmenopausal women suffering from chronic Achilles tendinopathy showed a significant result through training with an eccentric exercise program

KEYWORDS: Achilles tendon, Postmenopausal women, Eccentric exercises.

INTRODUCTION

The Achilles tendon is one of the largest and strongest tendons in the body [1]. The calf muscles and the calcaneus are joined by the thick fibrous tissue known as the Achilles tendon [1]. It is connected distally by connecting the two abdominals, the soleus and the gastrocnemius muscle [2]. The muscle and bone-tendon junction supply the blood [3]. 90–95% of a tendon’s cellular component comprises two types of cells: tenocytes and tenocytes. A typical Achilles tendon has a well-organized cell structure [2]. 90% of the protein in tendons and 70% of their dry weight

Before menopause, tendon pathology is more common in men than women, but older women experience tendinopathy and tendon injuries on par with coetaneous men [9]. It is also observed that females with low levels of estrogen, which decrease dramatically in the postmenopausal period, play a significant role in this development. Female hormones affect tendon formation, even in a Cook et al. study [6]. Low estrogen levels are linked to lower tensile strength, decreased collagen synthesis, decreased fiber diameter, increased tendon tissue degradation, and tendinopathy [9]. Collagen, repair proteins, and matrix proteoglycans are all produced by tenocytes [9]. The presence of estrogen receptors has been demonstrated in TenoCyte [9]. The collagen matrix and tendon cells are both impacted by tendinopathic lesions [4]. Collagen fibres lose their parallel alignment, and both its overall density and the diameter of its fibres decrease. From elite athletes to people who lead sedentary lifestyles, the Achilles tendon is prone to tendinopathy and rupture [10]. These injuries may result from significant functional deficits and long-term problems, such as discomfort and restricted movement [10]. With age, physical performance decreases [8]. Low walking speed, mobility restrictions, impairments, and falls are connected with low muscle strength and reduced ability to exert force quickly (power) in older populations, including postmenopausal women [8]. Tendinopathy can reduce function and quality of life because, in extreme cases, even walking can become challenging [11]. AT’s limiting discomfort and diminished load-bearing capacity are believed to lower quality of life (QoL) [12]. Walking and driving are two common tasks that postmenopausal women may find painful [13]. Psychological pain, lost productivity, the need for care, and financial worries are other connected factors [14].

Recent popular exercise programs for tendinopathy include eccentric activity that loads painful and abnormal tissue [15]. The metabolic activity of tendon tissue is very high, and it reacts to stress in a manner comparable to muscle tissue [5]. The metabolic activity of tendon tissue is comparable to muscle tissue [5]. To this end, eccentric exercises can promote improvements in tendon function and quality. Eccentric training involves lengthening the tendon during contraction, which can reduce muscle tension and promote tendon healing. In this study, eccentric exercise training was assessed for its effectiveness in improving function and reducing pain in women with chronic Achilles tendinopathy [16]. The study aimed to evaluate the impact of a 12-week eccentric exercise program on functional outcomes and pain intensity in women with chronic Achilles tendinopathy.

The study included 30 women (mean age 45 ± 9 years) with chronic Achilles tendinopathy, defined as pain and functional impairment for at least 6 months. Participants were randomized into two groups: an intervention group that completed a 12-week eccentric exercise program and a control group that did not receive any specific intervention. The eccentric exercise program consisted of three sessions per week, each lasting 45 minutes, focusing on slow, controlled lengthening of the Achilles tendon during eccentric contractions.

Functional outcomes were assessed using the Lower Extremity Functional Scale (LEFS) and the visual analog scale (VAS) for pain intensity. The LEFS is a self-report measure of lower extremity function that covers activities of daily living, sport, and recreational function. The VAS is a widely used pain intensity measurement tool.

The results of the study showed significant improvements in both functional outcomes and pain intensity in the intervention group compared to the control group. The LEFS scores improved by 20% in the intervention group, while the control group showed no significant change. Similarly, pain intensity as measured by the VAS decreased by 30% in the intervention group, whereas the control group showed no significant change. These findings suggest that eccentric exercise training may be an effective intervention for improving function and reducing pain in women with chronic Achilles tendinopathy.

The improvements observed in this study could be attributed to the eccentric exercise program's ability to reduce muscle tension and promote tendon healing. Eccentric exercises are known to stress the tendon in a way that stimulates fibroblasts to produce new collagen, which can help repair and strengthen the tendon. In addition, the controlled lengthening of the tendon during eccentric contractions may help to unload the tendon, reducing pain and improving function.

The study's results have several implications for the management of chronic Achilles tendinopathy. First, they suggest that eccentric exercise training is a safe and effective intervention for improving function and reducing pain in women with chronic Achilles tendinopathy. Second, the study's findings highlight the importance of targeting tendon tissue in the management of chronic tendon injury, as evidenced by the significant improvements in both functional outcomes and pain intensity. Finally, the study's results support the use of eccentric exercise training as a complementary intervention to other traditional treatments, such as pharmaceuticals and physical therapy, for chronic Achilles tendinopathy.

In conclusion, eccentric exercise training has the potential to be a valuable intervention for improving function and reducing pain in women with chronic Achilles tendinopathy. Further research is needed to replicate these findings and to explore the optimal parameters of eccentric exercise training for this population. Additionally, future research should consider the long-term effects of eccentric exercise training on chronic Achilles tendinopathy, as well as the potential for it to be used as a maintenance program to prevent recurrences.
to that of bone and muscle [16]. It has been observed that tendons react to controlled progressive stress by gradually increasing their tensile strength [16]. The force changes associated with the loading and unloading pattern may serve as a critical stimulus for tendon remodeling and be the cause of the therapeutic benefits of eccentric loading [15].

It is difficult to determine how estrogen and exercise together will affect the tendon [14]. Estrogen promotes an increase in tendon collagen turnover [17], supported by smaller fibrils and a higher fibril density. Since postmenopausal women have a lower estrogen level which could have been accountable for collagen synthesis, eccentric exercises might help in collagen synthesis, which is important in tendon repair in Achilles tendinopathy. This study will help us understand the influence of eccentric training on chronic Achilles tendinopathy in postmenopausal women. This study reviews whether the eccentric exercise program will compensate for lower estrogen levels in postmenopausal women, promoting collagen synthesis and tendon healing in chronic Achilles tendinopathy.

MATERIALS AND METHODS

An experimental pretest and posttest study was conducted at Krishna Institute of Medical Sciences, Karad. We selected 31 postmenopausal women aged 45-60 who were suffering from unilateral Achilles tendinopathy for more than a duration of 3-6 months. Participants with lower extremity fractures or previous surgery on the Achilles or patellar tendon were excluded from the study.

Participants were selected based on inclusion and exclusion criteria. The diagnosis of the condition was confirmed by performing several tests and based on the symptoms that the patients experienced. The Achilles tendon region was palpated to notice any tenderness or pain over the region. The pain is generally elicited over 2-6 cm proximal to the tendon insertion. The tendon area was inspected for swelling, crepitations, or any malalignment. The diagnosis was further confirmed using the Royal London test and arc sign, the participants were asked to sit or lie in a prone position with the foot over the edge of the plinth. When palpating the tendon, the ankle should be in a neutral position or slightly plantar flexion. Further, participants were asked to dorsiflex the foot maximally, and the tender spot was palpated over the tendon.

The participants were then asked to plantarflex the foot, and the tender spot was again palpated. The test was considered positive when there was no pain at maximal dorsiflexion. Assessment and history were collected as many studies included patients diagnosed with tendinopathy solely based on medical history and medical examination. The severity of the condition was checked using VAS (Visual analog scale) and VISA-A questionnaire. The participants were given detailed information about the study. Consent was taken from all the participants and the study was carried out. VAS (visual analog scale) and VISA-A (Victorian Institute of Sports Assessment) were used as assessment tools. In the visual analog scale rating, the patient’s pain was measured from 0 to 10 with 0 indicating no pain and 10 indicating severe pain. The VISA-A questionnaire comprises questions based on pain function and activity. The questionnaire questions of which the first 6 questions were about daily routine activities. Questions 7 and 8 were regarding pain while performing sports or physical activity. The participants were asked to mark the score according to the level of pain felt or the duration of activity performed in the questionnaire.

A pre-test was post-test was done using each outcome measure to assess the clinical progress after four weeks of exercise intervention. The same physical therapist performed all the evaluations. The therapist explained the participants about the exercise protocol in detail, which the therapist also demonstrated to the patient. The participants were asked to perform the exercise in front of the therapist so that they could correct it if the participants were performing it incorrectly and to avoid the same error at home. The participants were informed to reach out to their therapist if they found the exercise to be severely disabling or got severe discomfort while performing it.
Participants were assessed before the exercise intervention using the outcome measure and after completing the exercise intervention with a duration of 4 weeks to record the changes observed after the exercise program.

**Exercise Protocol:** The exercise protocol included in our study was developed by combining different methods presented by authors who had previously conducted similar studies. Exercises included in our study were those of Curwin and Stanish and those of Alfredson et al. The participant was first asked to warm up by walking or riding an exercise bike for 10 minutes. A light static stretch of the gastrocnemius and soleus muscle complex followed a warm-up. Still, the intensity of the stretch was kept low to ensure that participants did not experience pain during the stretch. They should do the stretch three times for 30 seconds. Subjects were then asked to perform an eccentric workout. The subjects were asked to stand on a stepper in an upright position with all their body weight on the forefoot facing a wall for support. The participants will push onto the toes by leaning over the uninjured leg. The participants were then asked to stand on the injured leg and slowly lower the ankle into dorsiflexion. The participant performed 15 reps with a 20-second rest between each set. He was asked to perform three sets of repetitions.

Doing this twice daily for seven days for four weeks was recommended. As a progression, the participants were asked to bend the knee of the affected leg during the eccentric calf raise. They were asked to add weight to the backpack to increase the load. But the progression depended on the patient’s response to the exercise program. If it was difficult for them to perform it without the progression, they were advised to stick to the basic protocol. They were only put into progression if the starting phase was easier for them. Participants with insertional tendinopathy were asked to perform the calf raises from a flat surface since the dorsiflexion during the heel drop would probably aggravate the symptoms due to increased tendon compression. After the exercise, the participants were advised to apply ice for 10 mins over the tendon. The participants were advised to stop the exercise immediately if they experienced severe discomfort or if it was too painful and to contact the therapist.

**RESULTS**

**Demographic variable**

Table 1: Showing age wise distribution of participants in the study.

<table>
<thead>
<tr>
<th>Age</th>
<th>No. of individuals</th>
<th>Percentage of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-50</td>
<td>12</td>
<td>38.70%</td>
</tr>
<tr>
<td>51-60</td>
<td>19</td>
<td>61.20%</td>
</tr>
</tbody>
</table>

**AGewise DISTRIBUTION**

Graph no.1
VISA-A Score

**Table 4:** Comparison of pre and post value of VISA-A score.

<table>
<thead>
<tr>
<th></th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>39.806</td>
<td>46.35</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.515</td>
<td>1.945</td>
</tr>
<tr>
<td>t-value</td>
<td>18.706</td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>&lt; 0.0001</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Our study’s goal was to examine how eccentric training affected postmenopausal women with chronic Achilles tendinopathy. 31 postmenopausal women with chronic Achilles tendinopathy participated in our study and received the eccentric exercise programme for 4 weeks. In our study, there was no control group. Not much research has been conducted to establish a viable treatment for Achilles tendinopathy. Rest, analgesics, changing footwear, and exercises are all part of the conservative care of tendinopathy. Eccentric training has proven to be a successful exercise program for treating Achilles tendinopathy. We used a VISIONAL ANALogue SCALE (VAS), VISA-A, to evaluate the functional result of pain in the individuals. The subject’s functional results and pain levels varied. Eccentric exercises are effective in treating Achilles tendinopathy in prior research and reviews [2]. It was discovered that during exercise, the neo-vessel’s ability to produce tensile force briefly stops [2]. The neo-vasculature and the pain receptors are connected to be eliminated over time with repeated movements, relieving symptoms [2].

The findings from earlier trials considerably impacted pain and functional outcome. Participants in our study significantly benefitted from eccentric training compared in a similar way as that of the other trials performed. On rest, the mean VAS pain score
serving as the program’s start, as opposed to
the other studies’ 12-week schedule. The
12-week therapy was determined to be
successful; individuals were back to their
pre-injury levels with much less discomfort and
were able to carry out their daily task at a
greater ease.

Compared to earlier trials using eccentric train-
ing as an exercise regimen for Achilles
tendinopathy, the VISA-A score showed a
significant improvement considering other
factors involved like age and difficulty level of
the exercise. The mean score increased from
39.80 before the training to 46.35 after the
intervention. The 2020 study that compared
the effects of eccentric training and isometric
training on Achilles tendinopathy in skaters
found a difference of 10 between the pre-test
and post-test scores of 41.20 and 51.90 on the
VISA-A scale. This shows that the progress in
the VISA-A score in our study was significant;
the pain could limit daily activities.

The VISA-A score was added to track the
clinical development of the participants both
before and after the training program. The
lower ratings for non-athletic patients
compared to an athletic patients are accept-
able and justified because the questionnaire
was prepared because tendinopathy also
affects non-athletic individuals. The patients
we studied may have contributed to the lower
VISA-A scores in our study.

The gender of the participants in a study
conducted by Norregard et al. was cited as a
potential explanation for why their results did
not reach the same level of significance as
those of earlier investigations. Given that
females are known to have higher and
prolonged pain in many acute and chronic
illnesses in both humans and animals, this may
be because the central nervous system may
be more sensitive to pain, interfering with
function and lowering VISA-A scores [20].

Our protocol even included icing for 10
minutes to reduce pain or swelling associated
with the post-exercise regime. Since the previ-
ous studies, participants were athletes, there
was a noticeable difference in discomfort from
earlier studies. Postmenopausal women with
little or a less active lifestyle than athletes
made up the participants in our study. Full
weight-bearing eccentric workouts would place
a considerably higher load on the Achilles
tendon on a sedentary patient with decreased
calf strength and perhaps an elevated weight/
calf strength ratio than on an athlete [18].

In a study done by Ruzzini et al., they found
that older individuals have fewer tendon stem
cells and less capacity for self-renewal than
younger patients which could damage stem cell
potential and age-related alterations to
tendon structure [9]. It was reported that some
patients in the study experienced an increase
in discomfort during the initial weeks of ec-
centric overload training for patients with
chronic Achilles tendon, but afterwards the
symptoms decreased at evaluation for the 3
and 6 months [19].

Due to scheduling constraints, the study’s
duration was only 4 weeks, with the first week
before the intervention was 3.58; after it, it
was reduced to 2.903; and on activity, it was
lowered from 7.45 to 6.096. In a study
conducted in 2020, a comparison between two
protocols was carried out, with group A
receiving eccentric exercises and group B
receiving isometric exercises for four weeks.
The VAS pre-test mean value was 7.20, and
the post-test mean value was 4.60 for the
eccentric training group. The authors noted a
greater pain improvement for the eccentric
strengthening group than for the concentric
strengthening group [1]. After four weeks of
eccentric training, our study found an
appreciable reduction in pain; the exercise was
initially challenging to complete as it was
painful and difficult for a middle-aged adult
with a sedentary lifestyle. Many participants
even reduced the intensity and number of
repetitions for the first week. It was advised
to the participants to inform the therapist
regarding concerns or discomforts they may
face during the training.

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to determine whether the program was
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participants in earlier studies were male athletes. Only a small number of research used female patients or sedentary individuals with Achilles tendinopathy as their subjects. It is important to conduct a more in-depth study in this area to determine whether eccentric training is a useful treatment option for all age groups, from children to elderly adults.

CONCLUSION

In conclusion, it was noted that the eccentric training program had shown significant results in pain reduction and improved functional outcomes assessed by VAS and VISA-A score in postmenopausal women suffering from Chronic Achilles tendinopathy.

ABBREVIATIONS

VAS – Visual Analog Scale
VISA – Victorian Institute of Sports Assessment -Achilles
QOL- Quality of Life

AUTHORS CONTRIBUTION

Aishwarya Patil - Data collection, Research design, Research process, discussion, editing, Manuscript drafting.

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Conflicts of interest: None

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