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Original Research Article

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

Aishwarya Sanjay Patil [1], Poonam H Patil *[2].

[1] Intern, Department of Physiotherapy, Faculty of Physiotherapy, Krishna Institute of Medical Sciences "Deemed to be" University Karad- 415539, Maharashtra, India.

*[2] Assistant Professor, Department of Cardiopulmonary Sciences, Faculty of Physiotherapy, Krishna Institute of Medical Sciences "Deemed to be" University Karad- 415539, Maharashtra, India.

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.

Address for correspondence: Dr Poonam Patil, Assistant Professor, Department of Cardiopulmonary Science, Faculty of Physiotherapy, Krishna Institute of Medical Sciences "Deemed to be" University Karad – 415110, Maharashtra, India.
Phone number- 8806111153 **E-Mail:** dr.ppatil8388@gmail.com

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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][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 comprise collagen [4]. The most prevalent kind of collagen is type I [4]. It comprises 95% of the collagen in the tendon and is held in parallel bundles by small molecules of proteoglycans [4]. Due to the high percentage of collagen in the fibers and their close parallel arrangement in the direction of force, tendons have the highest tensile strength of all connective tissues [5]. Despite its strength, the Achilles tendon is more prone to tendinopathy because it is vulnerable to injury due to its limited blood supply and high tension. Clinical signs of tendinopathy include discomfort and dysfunction, and histological signs include tendon disrepair and degeneration [6]. With the prevalence of chronicity and recurrence, the prognosis is frequently poor6. Patients with tendinopathy typically have an overuse injury, which causes pain while moving, localized sensitivity to palpation, and a diminished tolerance to tension, which reduces functional strength [6]. Because the Achilles tendon is subjected to constant, prolonged, severe functional demands, Achilles tendinopathy is a common cause of disability in many athletes4. Despite this substantial relationship with physical activity, approximately 30% of Achilles tendinopathies are seen in people who do not engage in vigorous physical exercise [5]. According to reports, 7% and 9% of runners experience Achilles tendinopathy each year [6]. The average age of those with Achilles disease is between 30 and 50 years old [6], although the prevalence of Achilles tendon injuries rises with age.

Circulating levels of female sex hormones are linked to some tendinopathy risk factors [7]. Age, female sex, body type, and genetic susceptibility may impact circulating sex hormones and predispose people to tendon pain [7].

As estrogen levels decrease after menopause, collagen production may decrease, tendons may thin, and the incidence of tendon pathology increases7. The nature of the decline in bodily function differs by gender. During middle age, women deteriorate more rapidly than men [8].

These gender differences may be related to hormonal changes during menopause [8].

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 development9. 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[4]. 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 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.

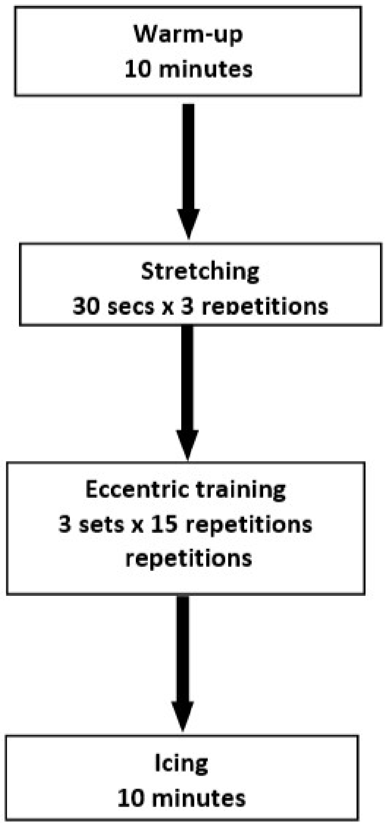
The participants were then asked to plantarflex the foot, and the tender spot was again palpated. The test was considered positive when there was no pain at maximal dorsiflexion. Assessment and history were collected as many studies included patients diagnosed with tendinopathy solely based on medical 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 -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.

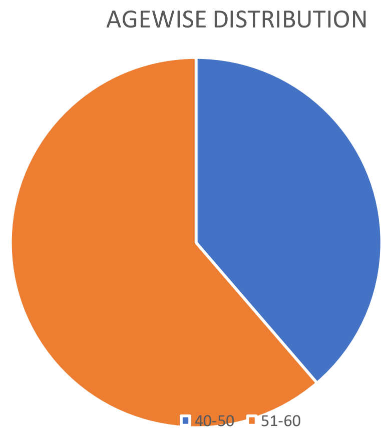


RESULTS

Demographic variable

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

Age	No. of individuals	Percentage of individuals
40- 50	12	38.70%
51-60	19	61.20%



Graph no.1

VAS (Visual Analogue Scale)

Table 2: Comparison between pre-value and post-value of VAS (on rest).

	Pre-test	Post-test
Mean	3.58	2.903
Standard Deviation	1.232	1.012
t-value	4.532	
P -value	< 0.0001	< 0.001

Interpretation: Patients treated with the prescribed exercise protocol showed decreased pain VAS (on rest). Statistically, a significant difference (p<0.0001) was seen in the post-assessment compared to pre-assessment. The eccentric training program has proved to be effective in reducing pain on rest in postmenopausal women, it can see in Table no 2.

VAS (Visual Analogue Scale)

Table 3: Comparison between pre-value and post -value of VAS (on activity).

	Pre-test	Post -test
Mean	7 .451	6.096
Standard Deviation	1.234	1.136
t-value	8.955	
p-value	<0.0001	< 0.0001

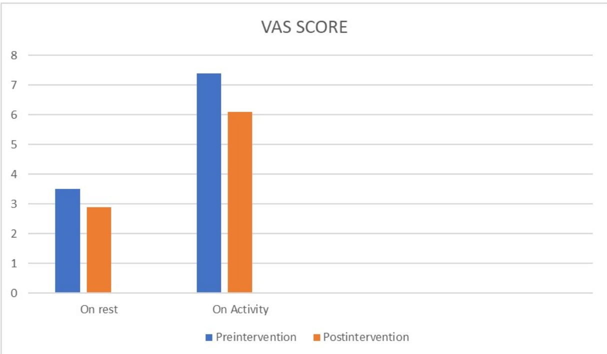


Fig. 2: Graphical representation of comparison between the pre -value and post-value of the mean VAS score (on rest and on activity).

Interpretation: There was a significant difference (p < 0.0001) observed when comparing the pre-assessment and post-assessment for VAS on activity for subjects trained with an eccentric training program as seen in table 3

VISA-A Score

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

	Pre-test	Post -test
Mean	39.806	46.35
Standard Deviation	1.515	1.945
t-value	18.706	
p-value	<0.0001	< 0.0001

VISA-A: Victorian Institute of Sports Association - Achilles S.D: Standard Deviation

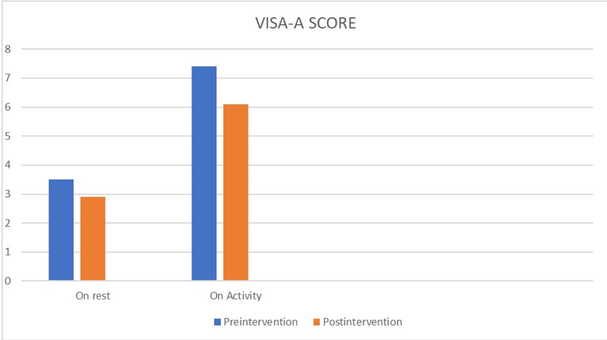


Fig. 3: Graphical representation of comparison between pre- value and post-value of the mean VISA-A score.

Interpretation: Patients functionally evaluation was done using VISA-A score, there was significant difference (p < 0.0001) observed in the pre-assessment and post-assessment in subjects treated with eccentric training program as seen in table 4.

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 VISUAL 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 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.

Our protocol even included icing for 10 minutes to reduce pain or swelling associated with the post-exercise regime. Since the previous 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 eccentric 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 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 training 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 acceptable 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 study had some limitations; the study duration was less than the previous research, resulting in lower scores or clinical outcomes. We did not include conventional groups to determine whether the program was superior to the other exercises for treating Achilles tendinopathy. It was discovered that 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

AUTHROS CONTRIBUTION

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

Poonam Patil – Research Process, Review of Literature, Discussion, Research Analysis.

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Ethical clearance: Study approved by Institutional ethics committee of Krishna Institute of Medical Sciences.

Conflicts of interest: None

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