

## Research Article

## Efficacy of Calf Stretching and Achilles Tendon Stretching in Reducing Pain and Improving Foot Function Disability in Patients with Plantar Fasciitis

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**Abstract:** Plantar fasciitis is a common foot complication. It is a disorder of the connective tissue which supports the arch of the foot. It causes pain in the heel and bottom of the foot that is usually most severe with the first steps of the day or following a period of rest. The present study deals with purposively selected 50 patients with plantar fasciitis aged 25-45 years from Physiotherapy Center of Guru Nanak Dev University, Amritsar, Punjab, India. The subjects were randomly allocated into two groups, calf stretching and Achilles tendon stretching for 4 weeks interventions. To evaluate the pain and foot function disability of the patients, visual analogue scale (VAS) and foot function index (FFI) were assessed from all the subjects in pre- and post-intervention stages. The results indicated significant reduction ( $p < 0.001$ ) in VAS and FFI in patients with Plantar fasciitis after 4-week interventions using both calf stretching and Achilles tendon stretching. The patients treated with Achilles tendon stretching had more significant ( $p < 0.001$ ) reduction both in VSA and FFI than the patients treated with calf stretching. In conclusion it could be stated that Patients who reported significant relief from symptoms at the end of 4-week interventions with Achilles tendon stretching were double that of the calf stretching.

**Keywords:** patients with plantar fasciitis, calf stretching, Achilles tendon stretching.

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### INTRODUCTION

Plantar fasciitis is a common foot complication with more than 80% of the cases resolving within 12 months, regardless of therapy (Gill, 1997). It is the most common among individuals aged 40-60 years (Buchbinder, 2004). In plantar fasciitis, the fascia undergoes degeneration and becomes tight, thereby leading to hypomobility within the ankle-foot complex, especially talocrural, subtalar and 1<sup>st</sup> tarsometatarsal joints. Limitation of talocrural joint dorsiflexion would require compensatory movements at more distal joints to allow forward progression of leg over the foot during stance phase of the gait (Prakash and Misra, 2004). Reduction in strength in some muscles of foot and ankle and abnormal foot alignment may lead to develop chronic degenerative changes in long-term plantar fasciitis (Thompson *et al.*, 2014). In fact, among several factors, biomechanical abnormalities are considered as important factors for the causes of plantar fasciitis (Bolivar *et al.*, 2013; League, 2008; Sullivan *et al.*, 2015).

So far treatment of plantar fasciitis is concerned, both operative and non-operative

interventions are in use. However, initially, non-operative interventions are advocated as approximately 90% of patients responded positively to these (Neufeld and Cerrato, 2008). Of these non-operative interventions, stretching, mobilization and manipulation, posterior night splints, iontophoresis, foot orthoses are practiced. Plantar fascia and Achilles tendon are anatomically connected and stretching of Achilles tendon was considered to be effective to plantar fasciitis (Phoomchai *et al.*, 2018). Effectiveness of calf muscle stretching for short-term treatment in plantar fasciitis was also reported (Radford *et al.*, 2007). Thus in the present study, an attempt has been made to compare the efficacy of calf stretching and Achilles tendon stretching for the reduction of pain and foot function disability in patients with plantar fasciitis.

### MATERIALS AND METHODS

#### Participants

The present study comprised of purposively selected 50 confirmed cases of plantar fasciitis (32 females and 18 males) aged 25-45 years from Physiotherapy Center of Guru Nank Dev University, Amritsar, Punjab, India. The subjects were then

randomly allocated into two groups, Group-A consisted of 25 patients those who went under the intervention of calf stretching for 4 weeks for 30-40 seconds hold for 3 repetitions per day and Group-B consisted of 25 patients those who went under the intervention of Achilles tendon stretching for 4 weeks for 30-40 seconds hold for 3 repetitions per day. The Age of the subjects was estimated from their date of birth. A written consent was obtained from all the subjects. The study was approved by the Institutional Ethical Committee (IEC).

### Anthropometric Variables

Three anthropometric variables, i.e. height, weight and BMI were measured from all the subjects using the standard techniques prescribed by Lohman *et al.*, (1988) and were measured in triplicate with the median value used as the criterion. Stadiometer (Holtain Ltd. Crymych, Dyfed, UK) was used for measuring standing height. The weight of the subjects was measured by weighing machine (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. with minimum clothing and bare foot of the subjects. Body mass index (BMI) was calculated from height and weight as follows:  $BMI = \text{weight (kg)} / \text{height}^2 (\text{m}^2)$ .

### Measurement of Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) was used to measure the pain of 24 hours as instructed by Bijur *et al.*, (2001). It is a validated method used widely for pain measurement.

### Measurement of Foot Function Index (FFI)

A modified Foot Function Questionnaire (Venditto *et al.*, 2015) was used for the study. The questionnaire was designed to give information as to

how the foot pain affected the patients' ability to manage in everyday life.

### Statistical Analysis

Data was analyzed using SPSS (Statistical Package for Social Science) version 20.0. Independent t-test was applied for all the variables between the patients with plantar fasciitis treated in Group-A and Group-B and between pre- and post-intervention within each group. A 5% level of probability was used to indicate statistical significance.

## RESULTS

Table 1 showed the descriptive statistics of anthropometric variables (age, height, weight and BMI) in patients treated with calf stretching and Achilles tendon stretching. The patients treated with calf stretching had higher mean values in age (35.28 years), weight (74.84 kg) and BMI (26.05 kg/m<sup>2</sup>), and lesser mean value in height (168.68 cm) than their counterparts treated with Achilles tendon stretching (33.08 years, 73.32 kg, 24.51 kg/m<sup>2</sup> and 171.84 cm respectively). However, no significant difference was noted in any case.

The descriptive statistics of VAS and FFI in pre- and post-intervention patients treated with calf stretching were shown in Table 2. The post-intervention patients treated with calf stretching had lesser mean values in VAS (4.64) and FFI (65.32) than their pre-intervention patient counterparts (6.28 and 86.84 respectively). However statistically significant reduction ( $p < 0.001$ ) were noted in VAS ( $t = 3.782$ , % decrement = 26.11%) and FFI ( $t = 3.413$ , % decrement = 24.78%) between them.

**Table 1.** Descriptive statistics of anthropometric variables in patients treated with calf stretching and Achilles tendon stretching

| Variables                | Patients treated with calf stretching |       | Patients treated with Achilles tendon stretching |       | t- value | p-value |
|--------------------------|---------------------------------------|-------|--|-------|----------|---------|
|                          | Mean                                  | SD    | Mean   | SD    |          |         |
| Age (years)              | 35.28                                 | 7.10  | 33.08  | 6.89  | 1.111    | 0.272   |
| Height (cm)              | 168.68                                | 12.30 | 171.84   | 10.59 | 0.973    | 0.335   |
| Weight (kg)              | 74.84                                 | 16.24 | 73.32  | 15.71 | 0.336    | 0.738   |
| BMI (kg/m <sup>2</sup> ) | 26.05                                 | 3.17  | 24.51  | 2.81  | 1.815    | 0.076   |

Table 3 showed the descriptive statistics of VAS and FFI in pre- and post-intervention patients treated with Achilles tendon stretching. The post-intervention patients treated with Achilles tendon stretching had lesser mean values in VAS (3.08) and FFI (32.92) than their pre-intervention patient counterparts (6.32 and 76.56 respectively). However statistically significant decrement ( $p < 0.001$ ) were found in VAS ( $t = 9.147$ , % decrement = 51.27%) and FFI ( $t = 8.855$ , % decrement = 57.00%) between them.

The descriptive statistics of VAS and FFI in post-intervention patients treated with calf stretching and Achilles tendon stretching were given in Table 4. The post-intervention patients treated with Achilles tendon stretching had lesser mean values both in VAS (3.08) and FFI (32.92) than their post-intervention patient counterparts treated with calf stretching (4.64 and 65.32 respectively). Statistically significant decrement ( $p < 0.001$ ) were found both in VAS ( $t = 3.908$ ) and FFI ( $t = 5.690$ ) between them.

**Table 2.** Descriptive statistics of VAS and FFI in pre- and post-intervention patients treated with calf stretching

| Variables | Pre-intervention with calf stretching |       | Post-intervention with calf stretching |       | t-value | p-value | % decrement |
|-----------|---------------------------------------|-------|--|-------|---------|---------|-------------|
|           | Mean                                  | SD    | Mean                                   | SD    |         |         |             |
| VAS       | 6.28                                  | 1.54  | 4.64                                   | 1.52  | 3.782   | <0.001  | 26.11%      |
| FFI       | 86.84                                 | 21.09 | 65.32                                  | 23.43 | 3.413   | <0.001  | 24.78%      |

VAS = Visual Analogue Scale, FFI = Foot Function Index

The post-treatment patients treated with Achilles tendon stretching had lesser mean values in VAS (3.08) and FFI (32.92) than their post-treatment counterparts treated with calf stretching (4.64 and 65.32

respectively). However the differences were statistically significant ( $p < 0.001$ ) in VAS ( $t = 3.908$ ) and FFI ( $t = 5.690$ ) between them.

**Table 3.** Descriptive statistics of VAS and FFI in pre- and post-intervention patients treated with Achilles tendon stretching

| Variables | Pre-intervention with Achilles tendon stretching |       | Post-intervention with Achilles tendon stretching |       | t-value | p-value | % decrement |
|-----------|--|-------|---|-------|---------|---------|-------------|
|           | Mean   | SD    | Mean  | SD    |         |         |             |
| VAS       | 6.32   | 1.21  | 3.08  | 1.29  | 9.147   | <0.001  | 51.27%      |
| FFI       | 76.56  | 18.59 | 32.92   | 16.17 | 8.855   | <0.001  | 57.00%      |

**Table 4.** Descriptive statistics of VAS and FFI in post-intervention patients with calf stretching and Achilles tendon stretching

| Variables            | Patients treated with calf stretching |       | Patients treated with Achilles tendon stretching |       | t-value | p-value |
|----------------------|---------------------------------------|-------|--|-------|---------|---------|
|                      | Mean                                  | SD    | Mean   | SD    |         |         |
| VAS (post-treatment) | 4.64                                  | 1.52  | 3.08   | 1.28  | 3.908   | <0.001  |
| FFI (post-treatment) | 65.32                                 | 23.43 | 32.92  | 16.17 | 5.690   | <0.001  |

## DISCUSSION

Plantar fasciitis is a disorder of the connective tissue which supports the arch of the foot. It causes pain in the heel and bottom of the foot that is usually most severe with the first steps of the day or following a period of rest (Cole *et al.*, 2005). The findings of the present study stated that post-treatment patients treated with both calf stretching and Achilles tendon stretching were significantly reduced in VAS ( $p < 0.001$ ) and FFI ( $p < 0.001$ ) than their pre-treatment patient counterparts. But the patients treated with Achilles tendon stretching had more significant ( $p < 0.001$ ) reduction both in VSA and FFI than the patients treated with calf stretching. Patients who reported significant relief from symptoms at the end of 4-week interventions with Achilles tendon stretching (%decrement of VAS and FFI 51.27% and 57.00% respectively) were double that of the calf stretching (26.11% and 24.78% respectively).

Digiovanni (2006) reported that a tight calf muscle and Achilles tendon were the main contributors to the condition. The results of the present study showed that stretching of these two structures was beneficial for reducing pain and dysfunction associated with plantar fasciitis. Radford *et al.*, (2007) studied the effectiveness of calf muscle stretching for the short-

term treatment (2 week stretching program) of plantar fasciitis and reported that statistically no significant difference in first step pain or foot health was found as compared to control group. Though, in the present study, the interventions with calf stretching were of 4 weeks and significant improvement was recorded. Muir *et al.*, (1999) studied the effect of a static calf stretching exercise on the resistive torque during passive ankle dorsiflexion in healthy subjects and stated that static stretching of calf had increased ankle dorsiflexion ROM but it did not produce any significant reduction in the passive mechanical resistance in to ankle dorsiflexion. The findings of the present study contradicted with the findings of both Radfeld *et al.*, (2007) and Muir *et al.*, (1999).

Mohamed (2015) reported significant reduction in global measures of pain and disability for patients with chronic plantar fasciitis with the interventions of Achilles tendon stretching. The identical type of findings were available (Digiovanni *et al.*, 2003; Phoomchai *et al.*, 2018, Cole *et al.*, 2005). In fact, the Achilles tendon and plantar fascia is anatomically connected. The possible reasons for the greater pain-relieving effect of the Achilles tendon stretching intervention could be that higher tension was generated within the Achilles tendon. With greater tension greater flexibility and range of motion were

expected. As it has been found that the tissue being stretched developed greater stretch tolerance (Knudson, 2006). This might then allow the tissue to move with less pain, This hypoalgestic effect of the stretching therefore helped to decrease the pain and increase the foot and ankle disability conditions of patients with plantar fasciitis (Phoomchai *et al.*, 2017). Small sample size was a limitation of the present study.

## CONCLUSION

From the findings of the present study, it could be concluded that 4-week interventions with both calf stretching and Achilles tendon stretching were significantly effective to reduce the VAS and FFI in patients with plantar fasciitis, the patients treated with Achilles tendon stretching had more significant reduction of the outcome variables and the percent decrement of pain and foot function disability were double that of the calf stretching.

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## CONFLICT OF INTEREST

Nil.

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