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Original Research Article

# A Comparative Study of Alfredson Protocol Versus Silbernagel Protocol on Achilles Tendinopathy

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## ABSTRACT

**Background:** Achilles tendinopathy (AT), an overuse injury affecting the largest and strongest tendon in the body, accounts for 20% of all tendon injuries and has an annual incidence of 1.85–2.35 per 1,000 individuals. Prevalence rises to 50% among high-intensity runners and 6% in the general population. Symptoms include pain, swelling, and reduced function, with nodular swelling and compromised plantar flexor function in chronic cases. Diagnosis involves clinical examination (e.g., Royal London Hospital test) and imaging with ultrasound or MRI. Treatment includes stretching exercises, various contraction therapies and passive modalities like orthotics, cryotherapy and acupuncture.
**Methods:** A quasi-experimental study was conducted on 30 patients aged 18 to 45 years diagnosed with Achilles tendinopathy (AT). Participants were randomly assigned to two equal groups: Group A received the Alfredson protocol while Group B received the Silbernagel protocol. Treatment was administered over 12 weeks, six days per week. Outcomes were evaluated using the Visual Analogue Scale (VAS) and the Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire at baseline, the 6th week and the 12th week.
**Conclusion:** The study concluded that both the Alfredson and Silbernagel protocols effectively reduced pain and disability in AT with the Silbernagel protocol showing significantly greater improvements by week 12.

***Keywords:*** Achilles tendinopathy, Alfredson, concentric exercise, eccentric exercise and Silbernagel

## INTRODUCTION

Tendinopathies are among the most prevalent orthopedic disorders. The Achilles tendon, which is the largest and strongest tendon in the human body, is susceptible to both traumatic and degenerative processes. It is the most affected tendon, accounting for 20% of all tendon injuries.[1] An excruciating overuse injury to the Achilles tendon is called Achilles Tendinopathy (AT).[2]

Each year, 2 to 3 per 1,000 individuals experience Achilles tendinopathy (AT), with prevalence reaching up to 50% among high-intensity runners. AT affects approximately 6% of the general population.[3] The incidence of Achilles tendinopathy (AT) in the general population is 1.85 per 1,000 individuals [6], increasing to 2.35 per 1,000 among adults aged 21 to 60. [4]

Achilles tendinopathy typically presents with pain, swelling and reduced function, especially during walking and high-impact activities.[5] In chronic cases, exercise-induced pain remains the primary complaint with reduced crepitus and effusion. A nodular swelling is often present and both the plantar flexor muscle and tendon function are compromised. [6,7]

Imaging supports the diagnosis of Achilles tendon pathology with ultrasound (US) and magnetic resonance imaging (MRI) being the most effective tools for evaluating the tendon.[8] The history of Achilles tendinopathy (AT) is often typical but not diagnostic. Inspection and tenderness on palpation are key diagnostic criteria. Williams described the painful arc sign and the Royal London Hospital test (RLHT) is commonly used in clinical practice.[9]

The management of AT has involved the use of numerous passive treatment therapies, including injections, iontophoresis, acupuncture, ultrasound, orthotics, wearing a night splint, vibration and cryotherapy, and a wait-and-see strategy.[7] It also includes stretching of gastrocnemius, soleus and hamstring.[10] Researchers have employed eccentric, concentric, isometric and isokinetic contractions, either separately or in combination. [11]

## MATERIALS & METHODS

A Quasi-experimental study was conducted in the OPD of orthopaedics GGMCH and OPD of University College of Physiotherapy in Faridkot, Punjab from September 2024 to march 2025. The study included 30 subjects aged 18 to 45 years with unilateral Achilles tendinopathy, characterized by localized pain and tenderness in the Achilles tendon without involvement of surrounding structures, pain during activities of daily living (e.g., walking, running, stair navigation), a positive Arc sign and pain on palpation with all patients capable of adhering to the prescribed exercise program.

Subjects were excluded if they had a ruptured Achilles tendon, other lower extremity or knee injuries that could influence symptom evaluation or training ability, previous tendon surgery or steroid injections within the last 12 months, bilateral symptoms, systemic diseases such as rheumatoid arthritis or diabetes mellitus, a fracture of the affected lower limb within the past 12 months, sudden onset of symptoms suggesting partial rupture or congenital deformities affecting the lower limb. Before the commencement of the study, ethical clearance was obtained from Institutional Ethical Committee of University College of Physiotherapy, Faridkot. Forty-seven subjects were initially screened at OPD of Orthopaedics department and OPD of University College of Physiotherapy, Faridkot, Punjab. Out of which, thirty subjects fulfilled the selection criteria and were enrolled in the study. After obtaining their written informed consent, the subjects were randomly divided into two equal groups, Group A (n=15) and Group B (n=15). Further, the subjects were assessed for pain and disability by VAS and VISA-A questionnaire respectively. Group A received Alfredson protocol and Group B received Silbernagel protocol. The intervention consisted of 6 session per week over duration of 12 weeks. The subjects were reassessed at the end of 6$^{th}$ week and after the treatment of 12 weeks.

### Interventions

In Group A (Alfredson protocol), subjects performed eccentric exercises using their body weight. They stood on their injured leg, lowered the affected limb by dorsiflexing the ankle, and performed the exercises with the knee straight to target the gastrocnemius and bent to target the soleus. The exercises were done twice daily, with three sets of 15 repetitions, gradually increasing from 1 set of 10 on day 1. Patients progressed by adding a 5 kg rucksack once they could perform the exercises without pain [12] with treatment monitored through weekly in-person visits and video calls.

In Group B (Silbernagel protocol), subjects performed concentric and eccentric heel raises on both legs and one leg, progressing from bipedal to unipedal exercises and from concentric to purely eccentric loading. Weight was added in 5 kg increments if pain remained below a 5/10 rating. [13] Treatment compliance was similarly monitored through videocalls and weekly OPD visits.

**Table 1 Exercises included in Silbernagel protocol**

| | |
|---|---|
| **Phase 1** | **Day 1-7** |
| Patient status | Experiencing pain and challenges with all activities, including significant difficulty performing 10 single-leg heel raises. |
| Objective | To enhance blood circulation in the lower leg, improve ankle range of motion, and incorporate balance and gait training, as well as a toe-raise exercise program. |
| **Phase 2** | **Week 2-3** |
| Patient status | Experiencing pain and challenges with all activities, including significant difficulty performing 10 single-leg heel raises. |
| Objective | To enhance blood circulation in the lower leg, improve ankle range of motion, and incorporate balance and gait training, as well as a toe-raise exercise program. |
| Treatment program | Perform the prescribed exercises daily.<br>• 2 sets of 20 repetition of regular two-legged concentric/eccentric toe raise.<br>• Perform regular concentric and eccentric single-leg toe raises. Begin with 3 sets of 5 repetitions and gradually increase by 2 repetitions each day until reaching 15 repetitions.<br>• Perform single-leg eccentric toe raises immediately after completing the regular concentric/eccentric toe raises. Start with 10 repetitions, increasing by 2 repetitions each day. Begin this exercise once you can perform 15 repetitions of the regular concentric/eccentric single-leg toe raises.<br>• Stretching of the calf muscles for 20 seconds 2 times a day |
| **Phase 3** | **Weeks 4-12** |
| Patient status | Tolerate the phase 2 exercise program effectively, with no pain at the distal portion of the tendon, and experiences potential changes in morning stiffness, either increased or decreased. |
| Objective | Progress to heavier strength training. |
| Treatment program | Included the same exercises as in Phase 2, with an additional progression in the toe-raise program, which now consisted of:<br>• Two sets of 20 repetitions of regular two-legged concentric/eccentric toe raises.<br>• Three sets of 15 repetitions of regular single-leg toe raises on a step (increasing by 2 repetitions per day if tolerated), immediately followed by:<br>• Ten repetitions of single-leg eccentric toe raises on a step (increasing by 2 repetitions per day if tolerated).<br>• Three sets of 20–100 repetitions of quick rebounding toe raises, starting with both legs and progressing to one leg.<br>• Follow with a 20-second calf muscle stretch. |

## STATISTICAL ANALYSIS

Data analysis was done by SPSS 21 software. Baseline characteristics were compared between groups using independent t- test. For all the outcome measures, Student's t test was used to assess the interventions effects within the groups. Alpha was set at 0.05, and the 95% confidence interval (CI) was calculated. If the significant difference was detected then independent t test was conducted.

## RESULT

Total 15 patients were taken in Group A out of which 11 were males and 4 were females with mean age of 30.53 and S.D.8.193 whereas in Group B out of 15 patients 10 were males and 5 were females with mean age 30.33 and S.D. 8.139.(Table 2)

At baseline (0th day), the mean VAS score for Group A was 7.73 ± 1.486 and for Group B, it was 7.53 ± 1.642 with a statistically significant improvement within each group (p = 0.001). The VISA-A scores at baseline were 0.432 ± 8.668 in Group A

and 0.430 ± 0.918 in Group B also showing significant within-group improvement (p = 0.001). However, between-group comparisons at this point revealed no significant differences (p = 0.729 for VAS and p = 0.955 for VISA-A).
At the 6th week, VAS scores decreased to 5.07 ± 1.280 in Group A and 3.73 ± 1.100 in Group B with significant improvements within each group (p = 0.001). VISA-A scores increased to 0.546 ± 0.109 in Group A and 0.614 ± 0.504 in Group B also showing significant within-group changes (p = 0.001). Between-group comparisons at this stage revealed statistically significant differences, with p-values of 0.005 for VAS and 0.037 for VISA-A, indicating greater improvement in Group B.
By the 12th week, the VAS scores further decreased to 2.13 ± 1.246 in Group A and 1.40 ± 0.507 in Group B with both groups continuing to show significant improvements (p = 0.001). VISA-A scores increased to 0.677 ± 0.135 in Group A and 0.763 ± 0.053 in Group B again with significant within-group improvements (p = 0.001). The between-group comparisons remained statistically significant at this point, with p = 0.044 for VAS and p = 0.030 for VISA-A, further supporting that Group B experienced superior outcomes over time. (Table 3)

**Table 2: Demographic details of the patients of Group A and Group B.**

| | Age | | N=15 | |
|---|---|---|---|---|
| **GROUP** | **Mean** | **S.D.** | **Males** | **Females** |
| Group A | 30.53 | 8.193 | 11 | 4 |
| Group B | 30.33 | 8.139 | 10 | 5 |

**Table 3: Comparison at 0th day, 6th week and 12th week score measurements of VAS and between VISA-A Group A and Group B**

| | VAS | | | VISA-A | | | VAS | VISA-A |
|---|---|---|---|---|---|---|---|---|
| | **Group A** | **Group B** | **Within Group P value** | **Group A** | **Group B** | **Within Group P value** | **Between Group P value** | **Between Group P value** |
| 0th day Mean ± SD | 7.73±1.486 | 7.53±1.642 | 0.001 | 0.432±8.668 | 0.430±0.918 | 0.001 | 0.729 | 0.955 |
| 6th week Mean ± SD | 5.07±1.280 | 3.73±1.100 | 0.001 | 0.546±0.109 | 0.614±0.504 | 0.001 | 0.005 | 0.037 |
| 12th week Mean ± SD | 2.13±1.246 | 1.40±0.507 | 0.001 | 0.677±0.135 | 0.763±0.053 | 0.001 | 0.044 | 0.030 |

## DISCUSSION

The study showed significant clinical improvements with both the Alfredson and Silbernagel protocols, but the rate and extent of improvement differed.
Groups A and Group B showed no significant differences in initial assessments. After 6 and 12 weeks, both groups improved across all variables. Group B demonstrated significantly greater reduction in pain and disability, indicating the superior effectiveness of the Silbernagel protocol for managing Achilles tendinopathy.
The subjects in Group A underwent Alfredson protocol. In the present study, a statistically significant reduction in pain and improvement in disability were observed, highlighting the effectiveness of the intervention. Pain, as measured by the VAS, decreased significantly after a twelve-week intervention.
Supporting these findings, a study by Marc Stevens et al. [14], also demonstrated significant benefits. Over a six-week intervention period, VAS pain and VISA-A scores was improved. In addition to the findings of this study, Murali K. Sayana et al. [15] reported that eccentric exercises are effective in nearly 60% of our patients, but sedentary individuals may not experience the same benefits as athletes.
The subjects in Group B underwent Silbernagel protocol. In this group there has been statistically significant difference.

The results of present study are consistent with the findings of Colin Griffin et al.[7] involving sixty eligible participants to evaluate rehabilitation approaches for chronic mid-portion AT. This study supports the effectiveness of the Silbernagel protocol.

Undoubtedly, this study offers valuable insights into the management of Achilles tendinopathy and provides evidence-based guidance for clinical practice. The study had a small sample size, a short duration and lacked long-term follow-up.

Undoubtedly, this study offers valuable insights into the management of Achilles tendinopathy and provides evidence-based guidance for clinical practice.

## CONCLUSION

In conclusion, the study found that both the Alfredson and Silbernagel exercise protocols effectively reduce pain and disability in AT. However, the Silbernagel protocol led to significantly greater improvements by the 12th week, suggesting it may provide faster or more pronounced early rehabilitation benefits. The study had a small sample size, a short duration and lacked long-term follow-up. Future research should address these limitations by including larger sample sizes, exploring diverse outcome measures and incorporating extended follow-up periods to evaluate long-term effects.

### *Declaration by Authors*

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**Conflict of Interest:** The authors declare no conflict of interest.

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