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Systematic Review

A Systematic Review Evaluating Diagnosis Methods and Treatment Protocols for Achilles Tendinopathy

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Purpose: Diagnosis and treatment protocols for Achilles tendinopathy can be categorized into various groups. However, their effectiveness varies depending on managing and reducing pain. Therefore, this systematic review analyzes and evaluates the diagnosis methods and compares treatment protocols' effectiveness for Achilles tendinopathy.
Methods: A systematic review was performed by searching six electronic databases: PubMed, Cochrane Library, Web of Science, Embase, MEDLINE Ovid, and ProQuest, which were searched for articles on the diagnosis and treatment protocols for Achilles tendinopathy. The studies that met the inclusion criteria were evaluated, and appropriate data was extracted.
Results: The ten articles that met the inclusion criteria were included in the study. Evidence from the review showed that the Alfredson protocol had a higher pain nd function improvement compared to the Stanish protocol, with a higher VISA-A score in the Alfredson than the Stanish protocol. The findings showed that combining the Alfredson eccentric exercise and Stanish Stretching exercises would significantly improve pain and function for patients with Midportion Achilles tendinopathy. This result showed that both protocols significantly improve pain and function in Achilles tendinopathy patients. Similarly, HSR and ECC showed no significant statistical difference in the VISA-A (Victorian Institute of Sport Assessment-Achilles) scores.
Conclusions: HSR is more favorable than ECC, while Alfredson is superior to the Stanish protocol. The VISA-A scores in Alfredson versus Silbernagel and ECC versus HSR did not provide any significant statistical difference between the groups. Alfredson and Silbernagel protocols and ECC and HSR show similar results in reducing pain.

Keywords: Silbernagel, Alfredson, HSR, Stanish, Tendon, training, conservative treatment.

Introduction

The Achilles tendon is the regularly injured tendon in the ankle and foot, mostly associated with athletic/sports activities.[1] Achilles tendinopathy incidence rate is at least 2 per 1000 individuals in general medical care, and its cumulative incidence rate can escalate to at least 50% in certain populations, such as marathon runners and jumping athletes.[2–5] The injury can affect the midportion[5] or distal insertion of the tendon due to its overload nature.[2] Handling tendinopathy is challenging, especially with metabolic conditions increasing in th population[6], thereby necessitating effective diagnostic and treatment methods. Outcome, measured by patient satisfaction using eccentric exercises, such as Alfredson, Silbernagel, ECC or HSR varies from 26.7% to 111% in different studies.[7–10]
Diagnostic methods for tendinopathy can be categorized into clinical tests and imaging.[11,12] The clinical tests include The Royal London Test, The Arc sign, and Palpation.[11] On the other hand, imaging methods include ultrasound[5], MRI (magnetic resonance imaging), and radiography.[12] Diagnostic methods are essential since, for successful treatment of Achilles tendinopathy, the diagnosis must be done accurately and timely. Despite several diagnostic tests (clinical examination, imaging, and clinical tests), it is difficult to identify the exact diagnosis and symptoms. Medical history and physical examinations are the main ways of diagnosing Achilles tendinopathy. The three main clinical examination measures used in Achilles tendinopathy are the Royal London Hospital test, palpation, and arch sign.[13,14]
Royal London Hospital test (RLHT) is usually performed on a patient in a prone position with the foot at the edge of a bench and the ankle located neutrally.[13] The test involves the determination of tenderness by palpating the Achilles tendon. The tenderness spot is analyzed by palpating in maximum ankle plantar flexion and ankle maximum dorsiflexion.[15] The test is considered positive for Achilles tendinopathy if the maximum ankle dorsiflexion pain is absent in the tenderness spot.[16] According to Reiman et al., the test has 54% sensitivity and 86% specificity.[14]
Palpation involves gently feeling the whole tendon length, squeezing the tendon proximally to distally, between the thumb and the index finger.[15,17] If the patient reports pain, the test is positive for Achilles tendinopathy. The test has a sensitivity and specificity of 64 and 81%, respectively.[14] Conversely, the arc test involves the patient being positioned the same way as in the RLHT.[14,16,18] Localized tendon thickening is usually searched by palpating the tendon in a distal to proximal direction. If the swollen area moves with the movement in the ankle, the test is considered positive for Achilles tendinopathy.[18] The sensitivity and specificity of the test are 42% and 88%, respectively.[14]
The diagnostic assessment of the Achilles tendon via the imaging modalities includes conventional ultrasonography, magnetic resonance imaging (MRI), and radiography.[19,20] Achilles tendon imaging is crucial in diagnosing and evaluating patients with clinical findings and symptoms of the alleged Achilles origin. However, the MRI, not a dynamic imaging modality, may not be adequately reliable in determining tears in the Achilles tendon.[19] Therefore, ultrasonography is more effective for identifying tears on tendons. On the other hand, radiography is essential in

treatment planning.[20] Furthermore, the identification of tendon swelling and increased soft tissue density in the Kager's fat pad is easily identifiable using radiography. Radiography is also a superior imaging modality in confirming the presence or absence of pre-existing Tendinopathy.[20]

Despite the historical description that Achilles tendinopathy is an inflammatory condition, recent studies have shown that Achilles tendinopathy is a failed tendon healing response with less inflammatory influence.[12,21] Several treatment protocols, such as eccentric[22] exercise, splinting, and orthoses, have been found beneficial in countering Achilles tendinopathy.[23,24] However, a recent narrative review shows that eccentric exercise therapy, especially the Alfredson protocol, is essential in treating mid-portion Achilles tendinopathy.[21] The Alfredson protocol involves eccentrically loading the plantar flexor muscle-tendon by performing heel drops on the injured side. The protocol prompts the patient to perform a total of 180 repetitions daily.[25,26] The patients are usually required to carry on with the exercises despite experiencing pain and can only stop if the pain becomes unbearable. On the other hand, Stevens and Tan's (2014) study shows that the "do-as-tolerated" eccentric protocol improves pain and function as opposed to the Alfredson protocol.[25] However, the protocol was lacking regarding the follow-up since it was only conducted for six weeks.

The other protocol the patients perceive to be beneficial is the Silbernagel protocol.[13,27] This protocol involves the concentric and later plyometric loading of the Achilles tendon, crucial in most sport activities.[8] The patients consider this protocol over Alfredson because the exercises are only done once daily.[27] Due to this, patients are encouraged to comply with the training exercises; thus, a better outcome is achieved. Additionally, the restoration of concentric muscular deficits is improved by combining the concentric and eccentric loading exercises. Additionally, heavy loading resistance protocol involves using high loads upon the tendon.[28] This exercise ensures the tendon is subjected to greater volumes of manageable loading (70 - 80%).[28] All these protocols and diagnostic methods are vital in treating and managing Achilles tendinopathy; however, their effectiveness varies. Therefore, this study aims to evaluate the diagnostic ways of appraising Achilles tendinopathy and its treatment protocols to establish the most effective techniques. The study will primarily focus on the non-surgical treatment protocols for Achilles tendinopathy.

Methods

Eligibility criteria

The inclusion and exclusion criteria were executed to identify the relevant studies that evaluated Alfredson, Silbernagel, "do-as-tolerated", Stanish, heavy loading resistance and eccentric training treatment protocols for Achilles tendinopathy. The studies were eligible for inclusion if they:

1. Described the diagnosis and treatment of non-insertional Achilles tendinopathy
2. Targeted a population Aged 18 years and above to evaluate their effectiveness among adults. The criterion was specifically significant due to the VISA-A questionnaire outcome measurement, which necessitates adult consent.
3. Conducted the treatment protocol on patients with symptoms lasting more than three months
4. Studies published from 2012 onwards include updated records evaluating diagnostic and treatment methods for tendinopathy.

On the other hand, studies were excluded as per the following criteria:

1. Studies in languages other than English to avoid direct translation of scientific terms.
2. Studies that focused on Achilles tendonitis and in vitro or animal studies
3. Studies that reported the operational treatment of Achilles tendinopathy
4. Studies that provided data from less than ten patients since the results did not provide sufficient comparison for the systematic review.

Information sources and literature search

A sensitive strategy on multiple electronic databases was conducted per the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) guidelines.[29] The electronic databases searched included Embase, MEDLINE Ovid, Web of Science, Cochrane Library, PubMed, and ProQuest. The "Advanced Search" tab in the Cochrane Library, PubMed, and other electronic databases was used in a search algorithm that allowed the use of "OR" and "AND" operators. The keywords used in the search for studies are Alfredson protocol, Eccentric training, Achilles Tendinopathy, clinical tests and imaging tests. The following is a detailed search strategy that was used:

((Tendinopathy) AND "Achilles tendon"/) OR "Achilles tendon" AND (tendinopathy OR tendinosis* OR tendonitis OR pain OR injury)) OR achillodynia*)) AND (Alfredson protocol OR Eccentric training OR Silbernagel OR Stanish OR clinical tests OR imaging tests) NOT (Animals/ NOT Humans/))*

The reference lists from the included studies were also searched to widen the scope of the database literature search.

Data extraction

Two reviewers were tasked with extracting relevant data. The reviewers analyzed the articles by PICO (Patient, Population or Problem; Intervention, Comparison, and Outcome) consensus. Any discrepancy was resolved through consultation with another reviewer. The extracted information included study ID (author(s) and year), setting (location), participants characteristics, study design, diagnosis and treatment methods, and main outcomes (i.e., pain scores (VISA-A) before the treatment protocol). For this systematic review, the main treatment protocols identified were Alfredson, Silbernagel, "do-as-tolerated," Stanish, heavy loading resistance, and eccentric training. The studies involving these treatment protocols were separately grouped and analyzed to evaluate the protocols' effectiveness in treating and managing Achilles tendinopathy.

Quality Assessment and risk of bias assessment

The review included both randomized controlled trials and one retrospective study design. A risk of bias assessment was performed for randomized controlled trials using the RoB 2 tool provided by Cochrane.[30] The assessed domains were missing outcome data, selection of the reported result, randomization process, outcome measurement, and deviations from the intended interventions. After assessing each domain, the risk of bias judgment was overall made and categorized as either "high," "some concern," or "low risk." [30] A Newcastle-Ottawa Scale (NOS) was used for quality assessment for the retrospective study. The scale evaluated three domains: comparability, selection, and outcomes. For each criterion used in these domains, a maximum of one star was given when the assessment information was well documented in the studies; otherwise, no star was given.

Results

While performing an initial search towards the diagnosis and treatment protocols of Achilles tendinopathy, 2300 relevant records were retrieved (Figure 1). Screening for duplicate articles, 1250 records were eliminated. Additionally, based on the eligibility criteria, from the 155 studies retrieved, 143 were excluded. Forty excluded studies were non-English studies, five were in-vitro studies, 46 focused on Achilles tendonitis, 30 had less than 10 participants as patients, and 24 of the studies conducted trials on patients less than 18 years old.

Study Characteristics

In the diagnosis of Achilles tendinopathy, two studies showed the comparison between MRI and Ultrasound.[31,32] Two studies focused on clinical tests and Imaging for Achilles tendinopathy diagnosis.[16,33] One study entirely focused on clinical tests.[16] On the other hand, one study entirely focused on the Alfredson protocol for the treatment protocols.[34] The other four studies compared the "do-as-tolerated" protocol,[25] Alfredson and Silbernagel protocol,[26] Alfredson and Stanish protocol,[35] and eccentric training, and heavy slow protocol.[36]

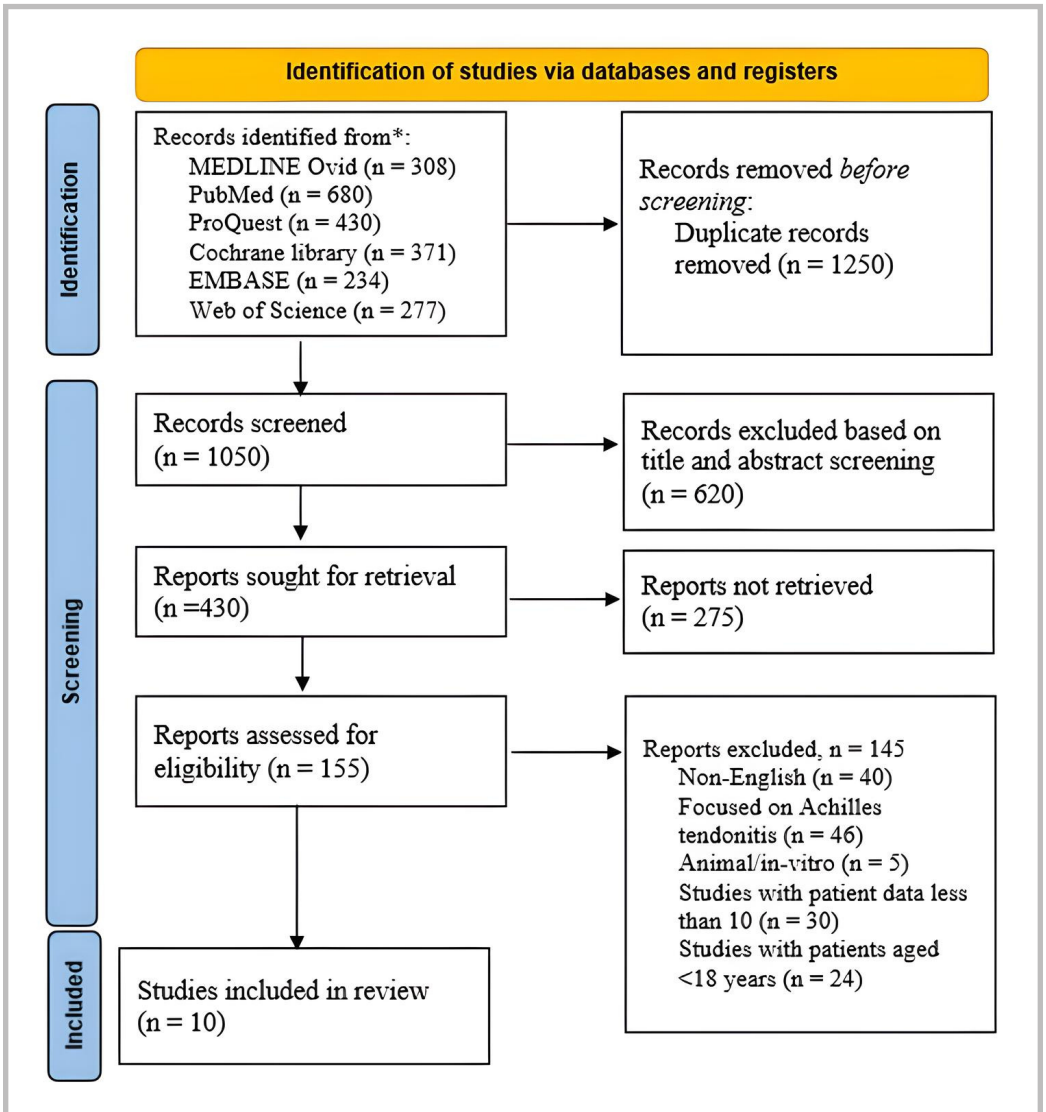

Figure 1. A PRISMA flow chart showing the search strategy

Risk of Bias and Quality Assessment outcome

All the studies except one[35] had a low risk of bias with some concerns about outcome data (Figures 2 & 3).

The quality of the study[31] was generally fair, as shown in Table 3.

Comparison of Achilles Tendinopathy Treatment Protocols

i. Alfredson versus "do-as-tolerated" Protocols

According to Stevens and Tan, based on the intention-to-treat and per-protocol analyses, there was no statistically significant difference between the VISA-A and VAS pain scores between the "do-as-tolerated" and Alfredson standard group after a 6-week intervention.[25] However, the VISA-A scores at three weeks showed a statistically significant difference. Additionally, the study shows that after a 12-week eccentric exercise program (Alfredson Protocol), the pain scores improved (i.e., the VISA-A score improved to 11.5).[25] Stevens and Tan (2014) showed that the VISA-A scores in the "do-as-tolerated" had significantly improved (15.0 points based on MCID) in the third week.[25] This significant change in the VISA-A score was attributed to the decrement of VISA-A scores in the Alfredson standard group. The VAS scores showed no significant changes between the Alfredson standard group and the "do-as-tolerated" at the end of the 2nd or 6th week.[25] The do-as-tolerated regimen cannot be considered less effective than the Alfredson protocol because the upper limits of 95% CIs correspond to a lower reduction in pain for the do-as-tolerated group. However, the lower limits of the 95% CIs show a significant possibility for the do-as-tolerated protocol to reduce pain. The study by Stevens and Tan16 shows

Table 1. Diagnosis methods for Achilles tendinopathy.

Study ID	Study design	participants	Diagnosis method (s)	Main outcomes
Johannsen et al., 2022[28]	RCT	100 patients	Ultrasonography corticosteroid	Ultrasonography-guided corticosteroids combined with exercises were linked to better outcomes (17.7-point VIS-A score) in Achilles tendinopathy treatment compared to placebo injections combined with exercise therapy.
Hutchison et al., 2013[9]	RCT	21 subjects	Clinical tests (Palpation, LRT, Arc sign)	The findings showed an accurate diagnosis of Achilles tendinopathy were crepitus (specificity 100%, PPV 1.00), The Arc Sign (specificity 100%, PPV 1.00), and The Royal London Test (specificity 93%, PPV .88).
Kim et al., 2021[22]	Retrospective	77 participants (28 males and 49 females) were used for the study. Mean age: 51.7 years	Ultrasonography	Ultrasonography was discovered to have the highest diagnostic accuracy in diagnosing insertional and mid-portion Achilles tendinopathy. MRI was also found to be superior to ultrasonography in the detection of incomplete tendon ruptures.
Albano et al., 2017[23]	RCT	43 patients aged 47.6±5.10	Ultrasound & MRI	Both MRI and ultrasound allow for clinical benefit linked with tendon size and power Doppler signal increase. However, MRI cannot be utilized as a clinical outcome predictor.
Dirrichs et al., 2018[24]	RCT	35 patients	SWE & ultrasound	SWE can predict tendon healing processes, unlike ultrasound. Similarly, it is more useful in monitoring treatment effects.

Note: RCT – randomized control trial; LRT – London Royal test; MRI – magnetic resonance imaging; SWE – shear wave elastography

that at the end of 6 weeks, there is no statistical difference in the VAS and VISA-A scored for the Alfredson and "do-as-tolerated" groups. However, at the end of the 6 weeks, both groups' pain scores had improved significantly.

The patient satisfaction with the treatment protocols was assessed at the end of the 6-week follow-up period. The results showed that 5 participants (38.4%) in the "do-as-tolerated group" and 4 participants in the Alfredson Standard group expressed excellent satisfaction.[25] Moreover, none of the participants from either group expressed poor satisfaction. The study did not provide any significant correlation between the satisfaction ratings and changes in VAS and VISA-A scores.

ii. Alfredson versus Stanish exercise Protocols

According to Stasinopoulos and Manias' study, the baseline VISA-A showed no significant difference between the Alfredson and Stanish protocol groups at the beginning of the trial.[35] However, by the end of the 12th week, a significant rise in the VISA-A scores for both groups was observed, i.e., the VISA-A score for Alfredson rose to 40 units and 25 units for the Stanish protocol.

iii. Alfredson versus Silbernagel protocols

From the Analyses of the VISA-A scores in the study by Habets et al.,[26] there was no significant statistical difference between the Alfredson and Silbernagel group, i.e., After the one-year follow-up period, the VISA-A score in the Alfredson group rose to 89.4±13.0 a.u., and in the Silbernagel group it rose to 83.2±22.5 a.u..[26] This improvement in the VISA-A score was concurrent with the clinical reports for Alfredson and Silbernagel loading protocols for midportion Achilles tendinopathy patients. Additionally, the study shows that the collected and analyzed data proved clinical symptoms were significantly improved in both the Silbernagel and Alfredson groups. However, the study could significantly improve the clinical improvement for both Silbernagel and Alfredson Group. Some interesting findings in the QOL and GPE (Global Perceived Effect) were found. During the 1-year follow-up period, the QOL in both groups improved significantly, with very few patients reporting mobility and pain problems. The results, however, showed that in the Silbernagel Group, more patients reported issues concerning depression compared to the Alfredson Group. Compared to the earlier findings (12 weeks), the number of patients in the Silbernagel Group that were considered to have improved was larger than that in the Alfredson Group. This significant change was attributed to age differences in both groups, i.e., Individuals in the Alfredson Group were younger than those in the Silbernagel Group. Since age is associated with patients' expectations, the study hypothesized that less satisfaction expressed by individuals in the Alfredson Group was due to their higher expectations. This hypothesis can, however, be considered speculative because the Age differences in the study are limited.

iv. Eccentric Training Protocol versus Heavy Slow Resistance Protocol

From the data Analyses by Beyer et al.,[36] there were no significant differences in the VISA-A scores in both groups, i.e.,

Table 2. Treatment protocols for Achilles tendinopathy.

Study ID	Study design	Participants	Duration of Symptoms	Treatment protocol	Follow-up period (weeks)	VISA-A increase at the follow-up period	Satisfaction	Main Outcomes
Stevens & Tan, 2014[16]	RCT	28 (11 men and 17 women). Age was greater than 18.	> 6 months	Alfredson eccentric-exercise & "Do-as-tolerated	6	15.4±9.3 for "Do as tolerated" and 9.1± 14.9 for Alfredson	38.4% of do-as-tolerated and 26.7% of Alfredson participants reported excellent satisfaction. No patient reported poor satisfaction in either group	A significant improvement was observed in both groups at the end of the 6-week follow-up. i.e., there was no significant statistical difference in the VISA-A scores for both groups
Stasinopoulos & Manias, 2013[26]	RCT	41 patients aged 35 to 55 years	> 3 months	Alfredson & Stanish exercise	12	40 unit rise in the Alfredson program and 25 in the Stanish group	-	The Alfredson program was found to have significantly improved function and reduced Calf muscle pain compared to the Stanish exercise protocol. The low-speed exercise observed in Alfredson protocol was essential in tissue healing for Achilles tendinopathy patients.
Habets et al., 2021[17]	RCT	86 recreational athletes aged 18 to 65	> 3 months	Alfredson & Silbernagel	52	25 in Alfredson & 34 in Silbernagel	50% of Alfredson and 77.3% of Silbernagel participants	The study shows that Alfredson and Silbernagel are beneficial in treating Achilles tendinopathy. Mid-portion Achilles Tendinopathy can be effectively treated with Alfredson or Silbernagel protocol on a supervised home-based program.
Beyer et al., 2015[27]	RCT	58 recreational athletes (32 men and 15 women) aged 18-60 years	Chronic midportion Achilles tendinopathy for >3 months	ECC & HSR	52	84±3.50 for ECC & 89±2.80 for HSR	76 % of the ECC and 96% of HSR patients were satisfied	Both HSR and ECC yielded positive (significant) effects in treating Achilles Tendinopathy. Patient satisfaction was better after 12 and 52 weeks.
Ram et al., 2013[25]	RCT	20 participants aged above 18 years	Not specified	Alfredson & HSR	12	45.4	2	The study showed that over time, the patients' syndromes were improved. However, in the home-based Alfredson protocol, most patients were unsatisfied with the improvement despite adhering to the 12-week heavy load eccentric exercises.

Note: RCT – randomized clinical trial; ECC – eccentric training; HSR – heavy slow resistance training.

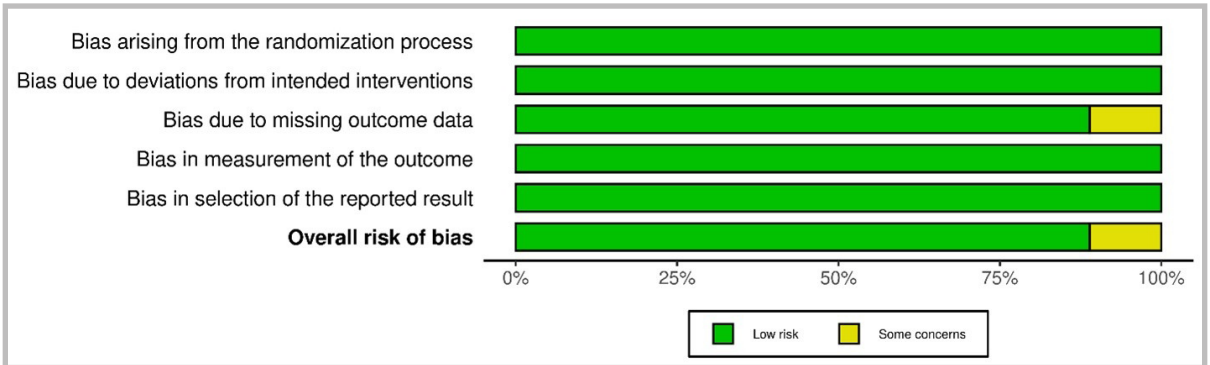

Figure 2. Risk of bias summary

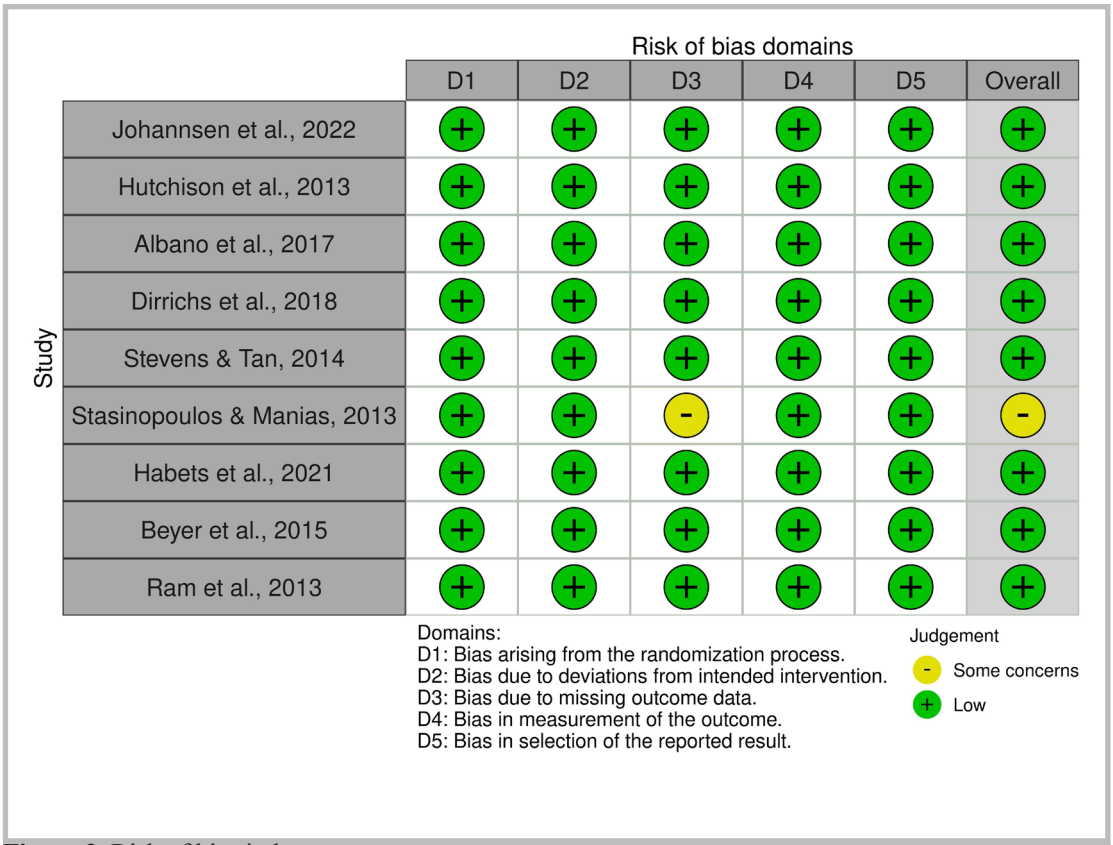

Figure 3. Risk of bias judgment

Table 3. Quality of the study (included).

Study	***Newcastle-Ottawa Scale***		
	Selection (Maximum 4)*	*Comparability (Maximum 2*)*	*Assessment (Maximum 3*)*
Kim et al., 2021[22]	****	*	**

the VISA-A score at the end of the 52-week follow-up period for the ECC group was 84±3.5 a.u., while for the HSR group it was 89±2.8 a.u.. Therefore, these results show that both treatments yielded similar improvements by the end of the 52-week follow-up. The study also shows that at the end of the 52-week follow-up, 21 of 22 HSR patients were satisfied with the protocol as opposed to the ECC protocol, where 19 of 25 patients showed satisfaction. The study attributes this patient satisfaction to the time taken to complete the exercises recommended in the two treatment protocols, i.e., ECC required two 22-minute training sessions every week while HSR required only 308 min per week.

Discussion

This systematic review was designed to investigate the effectiveness of different protocols in treating Achilles tendinopathy and analyze how to diagnose Achilles tendinopathy. One of the studies shows that the effective way of diagnosing Achilles tendinopathy is through clinical tests.[16] According to the study, early diagnosis and treatment of Achilles tendinopathy pose a challenge due to mild symptoms. Good quality evidence shows that diagnostic tests such as pain on palpation, arc sign, and Royal London Hospital Test are essential in diagnosing Achilles tendinopathy.[16] Three other studies show that ultrasound is the best imaging method for assessing Achilles Tendon.[31,32,37] However, one of the studies explains that in exceptional cases, such as a lack of ultrasound technology and inconsistent results between ultrasound and a clinical test, MRI can be used as the imaging modality.[31] However, a previous study by Astrom et al. suggests that Ultrasound and MRI are efficient in diagnosing

Achilles tendinopathy.[38] Additionally, a study by Kim et al. explained that the main reasons why ultrasound is mostly used in the diagnosis of Achilles tendinopathy over MRI are: it is readily accessible, has a relatively quick scan time, cheaper, allows for easy contralateral comparison and better patient tolerance.[31] It is important to note however that tendndon at imaging may be altered, but that does not neccesarly indicate a pathology.[39]

According to most studies in this systematic review, the VISA-A score results did not show any statistical difference in the patients' pain for the various treatment protocols. According to Beyer et al.'s study comparing HSR and ECC, the heavy resistance exercise that usually targets the muscle tendon has increased the muscle and tendon's physiological cross-sectional area and pennation angle.[36] This exercise has improved clinical outcomes in patients with Achilles tendinopathy. Additionally, the study hypothesis that ECC was more favorable than HSR was rejected because a larger percentage of HSR patients showed satisfaction with the protocol than the ECC patients who showed satisfaction with the protocol.[36] One study that compared the Alfredson and Stanish protocol concluded that the results showed much more reduced pain and improved function than the Stanish protocol in treating Achilles tendinopathy.[35] The authors note that the VISA-A score in the Alfredson group (40 units) at the end of the 6-month follow-up period was greater than that in the Stanish group (25 units).[35] Additionally, clinicians suggest combining the Alfredson eccentric exercises and Stanish stretching exercises would improve pain and function in patients with Achilles tendinopathy. The study on Alfredson versus Silbernagel showed no statistical differences between the groups.

A previous study by Sayana and Maffulli[40] provided a more significant change in the VISA-A score (25.0 a.u.) at 16 weeks compared to Stevens and Tan's study.[25] However, Stevens and Tan concluded that an optimal dosage (duration, frequency, and intensity) is essential for managing and treating Achilles tendinopathy.[25] Therefore, it was essential for a clinical predictor that guided the exercise dosage to be developed to monitor the improvements in the patients. On the other hand, reports from Herrington and Mcuhlloch[41] showed that at the end of the 4th, 8^{th,} and 12th week, the VISA-A scores improved to 19, 31, and 36 a.u., respectively.

Stasinopoulos and Manias's study showed that the eccentric calf muscle training exercise in the Alfredson protocol reduced pain and improved function more than in the Stanish protocol.[35] Such an outcome was attributed to the increased sets and repetitions of the calf training exercises observed in the Alfredson protocol. Conversely, a previous study by Jensen and Di Fabio[42] alludes that the Alfredson protocol results would be poor if the load of eccentric exercises were not increased as per the patients' symptoms.[42] Moreover, the improvement in pain and function observed in the Alfredson group was attributed to low-speed eccentric exercise at every session, which was ignored in the Stanish Protocol. Research by Stasinopoulous and Manias showed that the application of ice at the end of the treatment recommended by the Stanish Protocol has no benefit to Patients with Achilles Tendinopathy.[35] Visnes et al. claimed that in both exercise programs, avoiding painful activities is crucial in tendon healing.[43]

A study by Cannell et al.[44] showed that despite the Standard Alfredson exercises being adequate in treating tendon disorders, some patients could not respond to that protocol alone.[44] Hence, physical therapists have suggested that the eccentric exercises recommended in the Alfredson Protocol should be combined with Stanish's stretching exercises.[44] This claim is backed by Manias and Stasinopoulos's study that shows positive results when Alfredson's eccentric training is combined with Stanish's stretching exercises.[35] Additionally, studies by Hawary et al.,[45] Khan et al.,[46] and Ohberg et al.[47] explain that there appears to be a significant improvement in pain and function in treating Achilles tendinopathy when both protocols are combined. However, a lack of quality evidence makes it difficult to understand how the combined eccentric and static exercises lead to improved pain and function. Stasinopoulos and Manias claim that a home exercise program is recommended for patients with Achilles tendinopathy.[35] However, most patients fail to comply with the home-based exercise protocols. Therefore, it is essential to carry out the exercises in a clinical setting under the supervision of a physiotherapist. The study also claims good long-term clinical results can be observed in a shorter period under a supervised home exercise program.

On the other hand, Habets et al. conclude that eccentric contraction included in both protocols was fundamental in clinical improvement since concentric exercises were of little value.[26] Similarly, the study emphasized that reducing clinical symptoms loading, according to Alfredson or Silbernageleffectively reduced pain and improved function in patients with Achilles Tendinopathy. However, the results from the study did not show any significant difference in both protocols. The study findings also show that contraction loading was not significant in enhancing clinical effects, and therefore, both Silbernagel and Alfredson can be used in the treatment of Achilles tendinopathy confidently.

According to Mafi et al.,[48] pain and function in patients with Achilles tendinopathy is always seen when loading exercises are implemented. The data obtained after the 12-week intervention showed that the mean VISA-A score for the ECC group was 72 while that for HSR was 77 due to loading-based exercises only.[48] On the other hand, a study by Silbernagel et al., after a 5-year follow-up period, showed that 20% of the patients still show symptoms despite carrying out the loading exercise efficiently.[27] These results show that some patients may not recover fully from the Achilles Tendinopathy. The data analysis in the study shows that both ECC and HSR were effective in treating chronic Achilles Tendinopathy; the improvements usually last for over a year, even after the 12-week training is completed.

Limitations of the study

The primary limitation of our study is that it considered retrieving articles only published in English. The criterion challenges obtaining additional information on the same topic but written in a different language. The sample size of each literature source varied, so it was difficult to harmonize and relate results from each source. Similarly, most of the studies included in this systematic review were limited to subjective measures of VISA-A and VAS. Since the VISA-A relies on the patients to comprehend and complete a form truthfully and accurately, the results can be biased. Similarly, the study's assumption that patients' perception of pain can be standardized on a linear and numerical scale leads to bias. There is a new model proposed by Muprhy et. al.[49] that go beyond VIS-A and VAS, by adding patient-reported outcome measures (PROM) broadening the assessment of Achilles Tendinopathy called TENDINIS-A. Nevertheless we value a new approach but there is a need for additional clinical evidence to substantiate its superior clinical outcomes.

Practical Aplications

From the practical standpoint eccentric training (Alfredson or other) is recommended to reduce pain and improve function in

people with Achilles tendinopathy. It is important to notice that patient should be supervised with their adherence to exercise protocol at home.

Moreover the Alfredson protocol is better than the Stanish protocol for treating Achilles tendinopathy. Silbernagel and Alfredson show similar results. However, combining Stanish and Alfredson protocols might help reduce pain and improve function even more.

Conclusions

1. The data analyzed in the included studies indicate a preference for the Alfredson protocol over the Stanish protocol.
2. Combining the Stanish and Alfredson protocols could potentially enhance pain relief and function in patients with Achilles tendinopathy.
3. Both the Silbernagel and Alfredson protocols yield similar results in the treatment and management of Achilles tendinopathy.
4. The HSR (Heavy Slow Resistance) and ECC (Eccentric Exercise) protocols show comparable outcomes in pain reduction and function improvement for Achilles tendinopathy patients.
5. Patient satisfaction ratings favor the HSR protocol over the ECC protocol.
6. Eccentric training, specifically the Alfredson protocol, is recommended for improving pain and function in patients diagnosed with Achilles tendinopathy.
7. Home-based Alfredson protocol, with limited supervision, is crucial for effectively treating mid-portion Achilles tendinopathy.

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Ethical Committee approval

Not required as it was a systematic review.

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Author-s contribution

Conceptualization, K.J. and M.S.; methodology K.J. and M.S; validation and formal analysis, K.J. and M.S.; writing—original draft preparation K.J. and M.S.; writing—review and editing, K.J. and M.S. ;visualization, K.J. and M.S.; All authors have read and agreed to the published version of the manuscript.

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