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SYSTEMATIC REVIEW: STRATEGIES FOR THE IMPROVEMENT OF SYMPTOMATOLOGY IN ACHILLES TENDINOPATHY IN ATHLETES

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Summary. Achilles tendinopathy (AT) is one of the most common injuries among athletes, causing pain and impairment of tendon capabilities, as well as inflammation of the tendon body. This has a very high cumulative incidence, especially in elite athletes, and its main injury mechanism is the excessive load on the tendon accompanied by a short recovery period between loads. The risk factors that most influence this pathology are external, with internal factors also having relevance. Thus, the main objective of this review was to determine the optimal strategies for the recovery of Achilles tendinopathy in the field of physical activity and sport. In this work, articles extracted from the PubMed database were reviewed, selecting all those written in English, carried out on subjects injured with AT and who were in the readaptation period. All articles prior to 2010 were excluded. All the interventions performed in the different studies pointed to physical exercise as a very positive tool in the treatment of AT, with the most significant improvements being the reduction of tendon pain, improvement in functional capacities and an increase in the level of post-intervention satisfaction. In view of the results, eccentric and isometric training has proven to be beneficial for AT recovery, reducing symptomatology, pain and dysfunction in an injured person. However, heavy slow resistance (HSR) was the strategy that provided the best results on the study population.

Key words: Protocol, rehabilitation, pain, treatment, sport, health, tendon.

REVISIÓN SISTEMÁTICA: ESTRATEGIAS PARA LA MEJORA DE LA SINTOMATOLOGÍA EN TENDINOPATÍA AQUÍLEA EN ATLETAS

Resumen. La tendinopatía aquílea (TA) es una de las lesiones más comunes entre los atletas, produciendo dolor y deterioro de las capacidades del tendón, así como inflamación del cuerpo tendinoso. Esta presenta una incidencia acumulada muy alta, sobre todo en atletas de élite, y tiene como principal mecanismo lesional el exceso de carga sobre el tendón acompañado de un escaso periodo de recuperación entre cargas. Los factores de riesgo que más influencia tienen en esta patología son los externos, teniendo también relevancia los factores internos. Así, el principal objetivo de esta revisión fue determinar las estrategias óptimas para la recuperación de una tendinopatía aquílea desde el ámbito de la actividad física y el deporte. En este trabajo, se revisaron artículos extraídos de la base de datos PubMed, seleccionando todos aquellos redactados en inglés, llevados a cabo sobre sujetos lesionados con TA y que se encontrasen en periodo de readaptación. Se excluyeron todos los artículos previos a 2010. Todas las intervenciones realizadas en los diferentes estudios señalaron el ejercicio físico como una herramienta muy positiva en el tratamiento de la TA, siendo las mejoras más significativas la reducción del dolor del tendón, la mejora en las capacidades funcionales y un aumento del nivel de satisfacción post intervención. A la vista de los resultados, el entrenamiento excéntrico e isométrico ha resultado ser beneficioso para la recuperación de una TA, reduciendo la sintomatología, el dolor y la disfunción en una persona lesionada. Sin embargo, la resistencia lenta pesada (HSR) fue la estrategia que mejores resultados proporcionó sobre la población de estudio.

Palabras clave: Protocolo, readaptación, dolor, tratamiento, deporte, salud, tendón.

Introduction

Athletics is a sport that brings together running, jumping and throwing disciplines, among others, and whose difficulty lies in overcoming the opponent in speed and endurance.

Tendinopathy is one of the most common injuries in athletes (Pavone et al., 2019)especially in those who practice middle-distance events. Some of the most common tendinopathies are patellar tendinopathy, tensor fascia latae tendinopathy and goosefoot tendinopathy. Above all of them, Achilles tendinopathy stands out as the injury with the highest incidence in these athletes (Soidán and Giráldez, 2003).

In elite runners the cumulative incidence of Achilles tendinopathy is about 52%, these athletes also have a ratio of 6.1 injuries per 1,000 hours of racing (Lagas et al., 2020).

The Achilles tendon is the largest and strongest tendon in the human body. This is in charge of connecting both soleus and gastrocnemius (internal and external) to the calcaneus bone, located in the rear part of our foot. This set of structures is the so-called triceps suralis (Doral et al., 2010). The Achilles tendon does not end here, but continues through the plantar aponeurosis (Tenforde et al., 2016) and fundamentally carries out plantar flexion of both the foot and ankle.

Achilles tendinopathy is characterized by pain and impairment of the tendon's capabilities, as well as inflammation of the tendon body (Maffulli et al., 2020; Shakked and Raikin, 2017).

The fundamental injury mechanism in this pathology is the excess load on the tendon (Murtaugh and Ihm, 2013) and a short recovery period between loads. Excessive load on the tendon produces a reactive tendinopathy, which with increasing load leads to tendinosis, in which there is already tissue degeneration. Finally, reactive tendinosis occurs when the tissue is already severely affected (Rudavsky & Cook, 2014).

In relation to risk factors, it has not been determined that genetic aspects may have special relevance in the appearance of this pathology. Genetic contributors to collagen formation and tendon homeostasis might have some relationship but the results are ambiguous (van der Vlist et al., 2019).

Extrinsic risk factors are commonly known as those that have the highest incidence in an athlete's Achilles tendinopathy (volume of kilometers, number of sessions, running terrain, etc.). However, the most common is the combination of both extrinsic and intrinsic factors in the appearance of this pathology. Some of the most common intrinsic factors include: muscle strength, flexibility, previous injuries, age, body weight, and tendon temperature among others (Magnan et al., 2014).

Athletics is a cyclic sport in which the lower extremities are predominantly involved, especially the foot and all its joints (subtalar, metatarsophalangeal and ankle, among others). This type of athlete tends to have a limited range of passive dorsiflexion of the ankle joint, as well as reduced mobility in the subtalar joint. All this is a predisposing factor for injuries such as Achilles tendinopathy (Kvist, 1994) (Kvist, 1994).

The principle of progressive overload is the progressive increase of strain on the body during physical training (Haugen et al., 2021). This principle improves physical condition and reduces the risk of injury.

Therefore, the aim of the present review is to determine the optimal strategies for the rehabilitation of Achilles tendinopathy.

Method

For this review, a document search was conducted between February and the deadline of May 6, 2022. The Pubmed database was searched for articles using keywords such as tendinopathy, Achilles, eccentric work, runners, mobility, proprioception and isometric.

The Boolean operators used for the search were "and" and "or" and the search was conducted in English, discarding all articles prior to 2010.

Inclusion criteria were selected from studies carried out on injured subjects with Achilles tendinopathy who were in the process of readaptation. These articles had to be published from 2010 onwards choosing randomized control trials, clinical studies and clinical trials.

As exclusion criteria, all articles that were not original and were published before 2010 were excluded**.**

Results

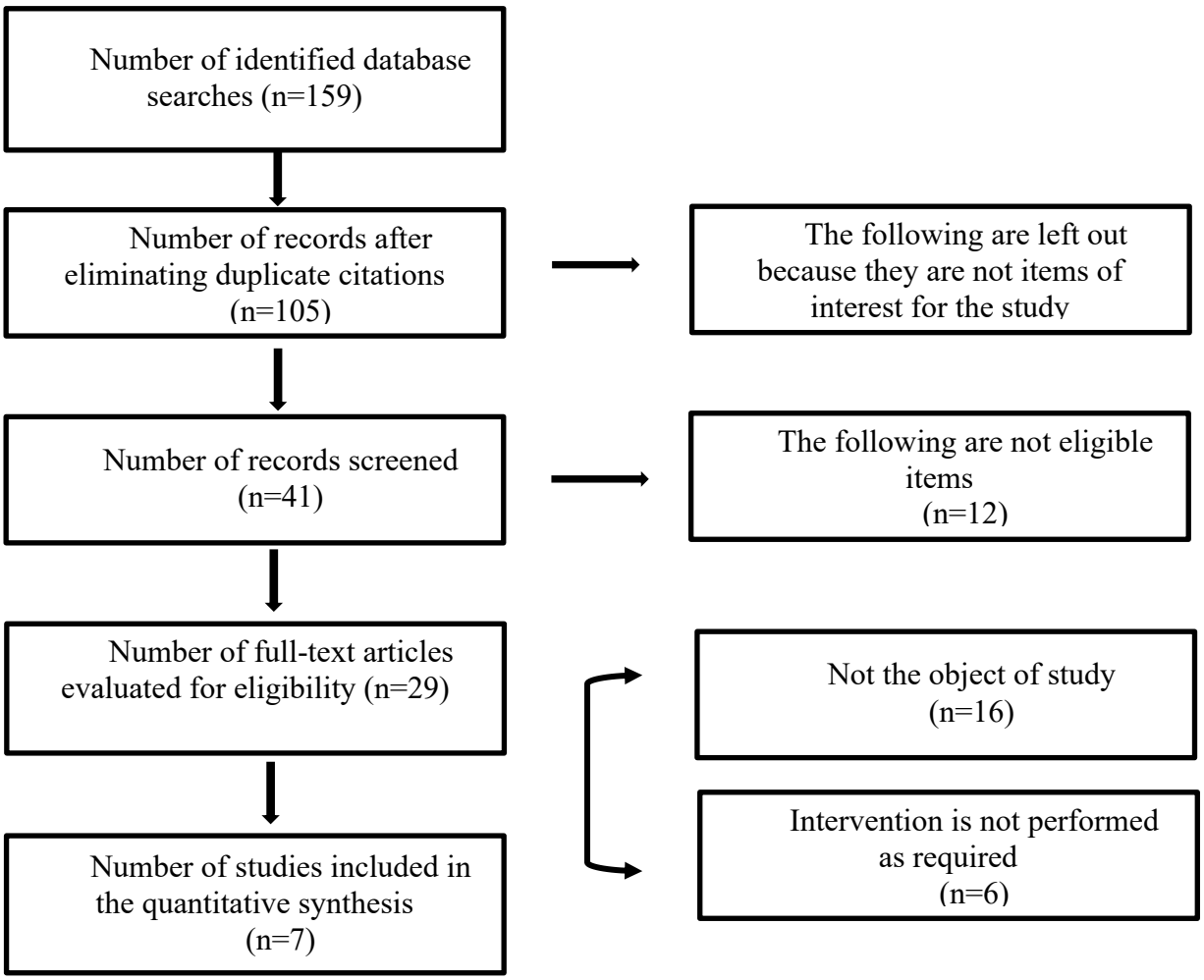

Figure 1. Flowchart

Table 1

Description of intervention studies

AUTHOR AND YEAR	POPULATION AND SAMPLE	INTERVENTION	TOOLS	RESULTS
Stasinopoulos and Manias (2012)	N=41 Stanish Group n=21 Alfredson Group n=20 All of them are recreational athletes between 35 and 55 years of age	12 weeks **Stanish Group**: 3x10reps eccentric 1x10reps 1x/day 6 weeks. 3x10reps eccentric 3 times a week for 6 more weeks with 2 min rest between sets in both. **Alfredson Group:** 3x15reps at slow speed, 2min rest between sets, 2 times a day 7 days a week. Heel descent with knee extended and flexed. Use uninjured leg for initial position.	VISA-A Questionnaire	Increase in VISA-A score in both groups compared to baseline (P<0.05). There were significant differences in the VISA-A score between groups at the end of treatment and at 6-month follow-up. Alfredson's exercise program group produced the greatest benefit (P<0.0005)
Stevens, Tan (2013)	N=28 Alfredson Group n=15 Group "les volume" n=13	6 weeks **Alfredson Group**: 3x15reps 2 times a day with knee extended and flexed, 180reps total. (heel falls) **Group "less volume**": Heel drops were performed 2 times a day trying to reach a volume similar to the first group. They could choose the volume of repetitions that was tolerable.	VISA-A Questionnaire Visual Analog Scale VAS Treatment satisfaction	VISA-A: There is a significant improvement in both groups. Two statistical tests were carried out, with significant differences at 3 weeks, with the Alfredson group being worse (P=0.004/P=0.007), but no significant differences were found at 6 weeks. VAS: There is a significant improvement in the two groups, but no significant difference between groups. Treatment satisfaction: There is no significant difference between groups.
Yu, Park, Lee (2013)	N=32 Eccentric strengthening group n=16 Concentric strengthening group n=16	8 weeks **Eccentric group**: 3x15reps, 30sec rest between sets, with 10sec of ex. time (exercises) **Concentric group**: 3x15reps, 30sec rest between sets. (different exercises)	Visual Analog Scale VAS Biodex system Muscular strength and endurance (Amato el al and Thelen et al) Biodex balance system	Pain: Pain decreased significantly in both groups (P<0.5) with the decrease in pain being significantly higher in the eccentric group. Muscular strength and endurance: muscular strength in knee extension and plantar and dorsal flexion of the ankle improved significantly in the eccentric group (P<0.05).

	All of them were men in their 20s and 30s.		Side-step test	Plantar flexion strength improved significantly in the eccentric group and dorsal flexion strength improved in both groups, being significantly higher in the eccentric group.
Beyer et al. (2015)	N=44 ECC group n=24 HSR group n=20 All of them were amateur athletes between 18 and 60 years of age.	12 weeks **ECC Group**: 3x15reps 2 times a day 7 days a week, 3sec reps, 2min rest between sets 5min between ex. Unilateral eccentric on injured leg on step with knee extended and flexed. **HSR Group**: 3 times per week. Same rest protocol as in ECC. - Machine heel raise (seated position and bent knee) - Press heel raise (knee extended) - Multipower heel raise (knee extended) From week 1 to week 12 the MRs go from 15 to 6. All ej were performed at maximum ankle ROM.	VISA-A Questionnaire Visual Analog Scale (VASh) and (VASr) Ultrasound	Both groups showed significant improvements in VISA-A (P<0.0001) and VAS from 0 to 12 weeks and were maintained until revision at week 52. There is no significant difference between groups, with both presenting similar improvements. There was a reduction in tendon thickness in both groups, with no significant difference between the two groups. Patient satisfaction with clinical outcome at 12 weeks was ECC (80%) and HSR (100%); at 52 weeks follow-up, ECC (76%) and HSR (96%)
Van der vlist et al (2020)	N=91 Group1 n=24, isometrics with ankle in plantar flexion Group2 n=18, isometrics with the ankle in dorsiflexion Group3 n=24, isotonic exercises Group4 n=25, rest.	Group 1 Group 2 Group 3 Group 4 Hip 90º 90º 90º 90º Sitting Knee 90º 90º 90º 90º 90º 90º Ankle 20º 10º 0-20º 2x45" 2x45" 2x45" 2x15reps Rest Hip 0º 0º 0º 0º Standing Knee 0° 0° 0° 0° 0 Ankle 20º 10º 0-20º 3x45" 3x45" 3x15reps Recovery times between exercises were 2min.	Visual Analog Scale (VAS) 10 unilateral jumps before and after the tests analyzed with VAS RPE	There was no significant reduction in pain in the 10-jump test after performing any of the 4 interventions. There were also no differences between the groups after the interventions.

Gatz et al. (2020)	N=30 Group EE n=15 EE+ISO Group n=15	12 weeks **EE Group** 3x15 2 times a day (on tiptoe on injured leg lowering heel below step, except for patients with insertion AT). Use uninjured leg to return to initial position. **EE+ISO Group**: EE protocol equal to group 1 and ISO protocol 5x45sec once a day, in 3 levels (passing from level to level in the absence of pain).	Ultrasound Numerical scales: VISA-A AOFAS Linkert Roles and Mandsley	Both groups improved significantly, but there were no significant interindividual differences (VISA-A; P=0.362) between the EE group and the EE+ISO group.
Bradford el al. (2021)	N=11 Group (first extension) n=6 Group (bending first) n=5 Nine men and two women participated.	12 weeks **First extension group**: 5 isometric plantar flexion contractions of 45sec duration at 70% of your MVIC with 2 min rest between sets. **Flexion group first**: performed the same protocol as group 1. Exercises: - Isometric plantar flexion of ankle (10º of dorsiflexion) with knee extended - Isometric plantar flexion of the ankle with the knee flexed to 80º - Position: seated, hip at 60º, lateral malleolus aligned with dynamometer lever arm. Isokinetic dynamometry to measure contractions.	Numerical Pain Rating Scale (NPRS)	GEE showed that there was no significant effect of knee position or exercise order on the percentage change in pain at the completion of isometric plantar flexion. However, although not significant (P=0.110) isometric plantar flexion in knee extension appeared to provide a 20% greater pain reduction compared to isometric plantar flexion in knee flexion.

Discussion and conclusions

The treatment of Achilles tendinopathy from a non-medical perspective is currently of great relevance. As noted by Silbernagel et al. (2020) in the treatment of this injury, from a conservative point of view, the process with the highest level of evidence is undoubtedly exercises. These provide mechanical load to the tendon and stimulate its remodeling, reduce pain and improve the strength and function of the calf muscles.

As we can see in the previous section, none of the exercise protocols described for the treatment of Achilles tendinopathy exerts adverse effects on the Achilles tendinopathy (Aicale et al., 2020) (Aicale et al., 2020). On the contrary, the populations on which the study is carried out always report an improvement in post-intervention pain as we can see in the VISA-A tests of Beyer et al. (2015) among others.

The physiological characteristics that both eccentric and isometric work produce in the muscle-tendon structure are mainly the ability to increase tendon compliance, less displacement of the myotendinous junction or reduce the elongation of the muscle fascicles.

As for the adaptations at the neural level, there is a change in the recruitment of motor units, increased excitability of motor neurons and an increase in inhibitory feedback, also increasing inflammatory sensitivity. Finally, remodeling also occurs in the extracellular matrix, stimulating the production of type 1 and 2 collagen, as well as the alignment of collagen fibers (Hyldahl et al., 2017).

There are no optimal loading factors for the tendon (Silbernagel et al., 2020)which seems to respond quite similarly, both to high loads (6RM) with a lower number of repetitions throughout the week, and to lower loads and more prolonged in time, as we see in the study of Beyer et al. (2015) in relation to pain. However, the level of patient satisfaction is higher in the case of heavy slow resistance (HSR). However, in this study by Beyer et al. (2015) long-term follow-up beyond 52 weeks is not included, so additional studies that include it are needed.

On the other hand Yu et al. (2013) maintains that, for pain reduction and improved function in patients with Achilles tendinopathy, eccentric load strengthening is more effective than concentric load strengthening. In this study by Yu et al. (2013), the eccentric protocol underwent a progressive increase in loads over the weeks, while the concentric program did not undergo this progressive increase, a factor that may be a determining factor for this improvement.

Another factor that has been studied to aid in the recovery of Achilles tendinopathy is isometric work (Silbernagel et al., 2020). However, throughout the development of this review it is observed that it does not improve when combined with eccentric exercise (Gatz et al., 2020) (Gatz et al., 2020). Additional studies comparing eccentric vs. isometric work in isolation are needed to see the benefits of each. However, van der Vlist et al. (2020) which develops a study of isometric and isotonic exercises does not show a significant reduction in post-intervention pain, nor a significant reduction in pain between groups. Although in this study there is a correct progression of the loads, when the RPE is less than 7, the weight of the exercises is increased.

Continuing with isometric exercise, Bradford et al. (2021) proposes that isometric exercise in isolation does provide improvements in Achilles tendinopathy and above all by performing exercises in knee extension, above all exercises carried out with knee flexion.

According to Jayaseelan et al. (2019) eccentric exercise provides great improvements in people suffering from Achilles tendinopathy. In the study conducted by Stasinopoulos & Manias (2013) we see how an eccentric work protocol based on a high volume of repetitions such as Alfredson's which is carried out morning and evening and with a higher volume of repetitions, produces greater improvements than Stanish's protocol which is only carried out once a day for 6 weeks and 3 times a week for a further 6 weeks.

Also Beyer et al. (2015) uses Alfredson's protocol in his work, but in this case he compares it with the HSR (heavy slow resistance) protocol, obtaining superior improvements in the level of satisfaction of his patients

For their part, Stevens & Tan (2014) compared Alfredson's protocol, mentioned above, with a similar one in which the difference lies in the fact that patients do not have to perform the full volume of repetitions involved in Alfredson's protocol, but that patients can choose the volume of repetitions that is tolerable. A significant difference was observed at week 3 in favor of the "less volume" group. At week 6 there are no differences between groups and both groups improve.

Finally, the main limitation encountered when carrying out the review was not being able to carry out the study on a specific population, for example, middle-distance athletes.

As future lines of research, it is interesting to know how the symptomatology of the lesion is altered at the moment when the protocol ends and the different patients stop performing the exercises, beyond the 1-year follow-ups that we can see in the studies.

Finally, it is concluded that eccentric and isometric training has positive effects on Achilles tendinopathy, reducing pain, improving the functional capacities of the different patients, as well as influencing their level of satisfaction. In view of the results, the slow heavy resistance seems to be the one that has provided the best results in the study population. In short, all the exercises mentioned are appropriate strategies when dealing with a patient with Achilles tendinopathy in the process of readaptation to physical sports activity.

that all the methods of readaptation seen throughout the review have positive effects on Achilles tendinopathy, reducing pain, improving the functional capacities of the different patients, as well as influencing their level of satisfaction. In view of the results, heavy slow resistance seems to be the one that has provided the best results on the study population, above eccentric or isometric work. In short, all the exercises mentioned above are appropriate strategies when dealing with a patient with Achilles tendinopathy in his or her process of readaptation to physical sports activity.

References

Aicale, R., Oliviero, A., & Maffulli, N. (2020). Management of Achilles and patellar tendinopathy: What we know, what we can do. *Journal of Foot and Ankle Research*, *13* (1). https://doi.org/10.1186/s13047-020-00418-8

Beyer, R., Kongsgaard, M., Hougs Kjær, B., Øhlenschlæger, T., Kjær, M., & Magnusson, S. P. (2015). Heavy slow resistance versus eccentric training as treatment for

achilles tendinopathy: A randomized controlled trial. *American Journal of Sports Medicine*, *43*(7), 1704–1711. https://doi.org/10.1177/0363546515584760

Bradford, B., Rio, E., Murphy, M., Wells, J., Khondoker, M., Clarke, C., Chan, Y., & Chester, R. (2021). Immediate Effects of two Isometric Calf Muscle Exercises on Mid-portion Achilles Tendon Pain. *International Journal of Sports Medicine*, *42*(12), 1122–1127. https://doi.org/10.1055/a-1398-5501

Doral, M. N., Alam, M., Bozkurt, M., Turhan, E., Atay, O. A., Dönmez, G., & Maffulli, N. (2010). Functional anatomy of the Achilles tendon. *Knee Surgery, Sports Traumatology, Arthroscopy*, *18*(5), 638–643. https://doi.org/10.1007/s00167-010-1083-7

Gatz, M., Betsch, M., Dirrichs, T., Schrading, S., Tingart, M., Michalik, R., & Quack, V. (2020). Eccentric and Isometric Exercises in Achilles Tendinopathy Evaluated by the VISA-A Score and Shear Wave Elastography. *Sports Health*, *12*(4), 373–381. https://doi.org/10.1177/1941738119893996

Haugen, T., Sandbakk, Ø., Enoksen, E., Seiler, S., & Tønnessen, E. (2021). Crossing the Golden Training Divide: The Science and Practice of Training World-Class 800- and 1500-m Runners. *Sports Medicine, 51*(9), 1835–1854. Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s40279-021-01481-2

Hyldahl, R. D., Chen, T. C., & Nosaka, K. (2017). Mechanisms and Mediators of the Skeletal Muscle Repeated Bout Effect. *Exercise and Sport Sciences Reviews*, *45*(1), 24–33. https://doi.org/10.1249/JES.0000000000000095

Jayaseelan, D. J., Mischke, J. J., & Strazzulla, R. L. (2019). Eccentric exercise for Achilles tendinopathy: A narrative review and clinical decision-making considerations. *Journal of Functional Morphology and Kinesiology*, *4*(2). https://doi.org/10.3390/jfmk4020034

Kvist, M. (1994). Achilles Tendon Injuries in Athletes. *Review article 5portsMed*, *18*(3).

Lagas, I. F., Fokkema, T., Verhaar, J. A. N., Bierma-Zeinstra, S. M. A., van Middelkoop, M., & de Vos, R. J. (2020). Incidence of Achilles tendinopathy and associated risk factors in recreational runners: A large prospective cohort study. *Journal of Science and Medicine in Sport*, *23*(5), 448–452. https://doi.org/10.1016/j.jsams.2019.12.013

Maffulli, N., Longo, U. G., Kadakia, A., & Spiezia, F. (2020). Achilles tendinopathy. *Foot and Ankle Surgery, 26*(3), (240–249). https://doi.org/10.1016/j.fas.2019.03.009

Magnan, B., Bondi, M., Pierantoni, S., & Samaila, E. (2014). The pathogenesis of Achilles tendinopathy: A systematic review. *Foot and Ankle Surgery*, *20*(3), 154–159). https://doi.org/10.1016/j.fas.2014.02.010

Murtaugh, B., & Ihm, J. M. (2013). *Eccentric Training for the Treatment of Tendinopathies*. www.acsm-csmr.org

Pavone, V., Vescio, A., Mobilia, G., Dimartino, S., di Stefano, G., Culmone, A., & Testa, G. (2019). Conservative treatment of chronic achilles tendinopathy: A systematic review. *Journal of Functional Morphology and Kinesiology, 4*. https://doi.org/10.3390/jfmk4030046

Rudavsky, A., & Cook, J. (2014). Physiotherapy management of patellar tendinopathy (jumper's knee). *Journal of Physiotherapy*, *60*(3), 122–129. https://doi.org/10.1016/j.jphys.2014.06.022

Shakked, R. J., & Raikin, S. M. (2017). Insertional Tendinopathy of the Achilles: Debridement, Primary Repair, and When to Augment. *Foot and Ankle Clinics*, *22*(4), 761–780. W.B. Saunders. https://doi.org/10.1016/j.fcl.2017.07.005

Silbernagel, K. G., Hanlon, S., & Sprague, A. (2020). Current clinical concepts: Conservative management of achilles tendinopathy. *Journal of Athletic Training*, *55*(5). https://doi.org/10.4085/1062-6050-356-19

Soidán, G., & Giráldez, A. (2003). Análisis de las lesiones más frecuentes en pruebas de velocidad, medio fondo y fondo analysis of the most frequent injuries in tests of speed, half and long distances. *Revista Internacional de Medicina y Ciencias de La Actividad Física y El Deporte*, *3*(12), 260–270. http://cdeporte.rediris.es/revista/revista12/artlesiones.htm

Stasinopoulos, D., & Manias, P. (2013). Comparing two eccentric exercise programmes for the management of Achilles tendinopathy. A pilot trial. *Journal of Bodywork and Movement Therapies*, *17*(3), 309–315. https://doi.org/10.1016/j.jbmt.2012.11.003

Stellingwerff, T., Bovim, I. M., & Whitfield, J. (2019). Contemporary nutrition interventions to optimize performance in middle-distance runners. *International Journal of Sport Nutrition and Exercise Metabolism*, *29*(2), 106–116. https://doi.org/10.1123/ijsnem.2018-0241

Stevens, M., & Tan, C. W. (2014). Effectiveness of the alfredson protocol compared with a lower repetition-volume protocol for midportion achilles tendinopathy: A randomized controlled trial. *Journal of Orthopaedic and Sports Physical Therapy*, *44*(2), 59–67. https://doi.org/10.2519/jospt.2014.4720

Tenforde, A. S., Yin, A., & Hunt, K. J. (2016). Foot and Ankle Injuries in Runners. *Physical Medicine and Rehabilitation Clinics of North America*, *27*(1), 121–137. https://doi.org/10.1016/j.pmr.2015.08.007

van der Vlist, A. C., Breda, S. J., Oei, E. H. G., Verhaar, J. A. N., & de Vos, R. J. (2019). Clinical risk factors for Achilles tendinopathy: A systematic review. *British Journal of Sports Medicine*, *53*(21), 1352–1361. https://doi.org/10.1136/bjsports-2018-099991

van der Vlist, A. C., van Veldhoven, P. L. J., van Oosterom, R. F., Verhaar, J. A. N., & de Vos, R. J. (2020). Isometric exercises do not provide immediate pain relief in Achilles tendinopathy: A quasi-randomized clinical trial. *Scandinavian Journal of Medicine and Science in Sports*, *30*(9), 1712–1721. https://doi.org/10.1111/sms.13728

Yu, J. H., Park, D. S., & Lee, G. C. (2013). Effect of eccentric strengthening on pain, muscle strength, endurance, and functional fitness factors in male patients with achilles tendinopathy. *American Journal of Physical Medicine and Rehabilitation*, *92*(1), 68–76. https://doi.org/10.1097/PHM.0b013e31826eda63

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