ARCHIVES OF HELLENIC MEDICINE: ISSN 11-05-3992

ORIGINAL PAPER
ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

Investigation of the application of the Pilates method in the rehabilitation of Achilles tendinopathy

OBJECTIVE **To investigate the application of clinical Pilates in daily clinical practice and to determine the intensity, frequency and dosage of execution in Achilles tendinopathy (AT).** METHOD **A cross-sectional study that followed the quantitative approach was carried out by administering an improvised questionnaire to a sample of physical therapists in Greece in order to collect and analyze data on the use of the Pilates method in rehabilitation and to investigate its use in AT as well as to determine the exercise regimen, the intensity and frequency of execution, as well as the dosage.** RESULTS **Out of the 45 physiotherapists who responded to the questionnaire, the majority (75.6%) were aware of the method. A percentage of 41.2% applied it in daily clinical practice, 78.6% had received relevant training and only nine of them applied it in AT rehabilitation. The majority of them performed two sessions per week for 3–6 weeks, 10 exercises of 10 repetitions in repeated sets with a break. 100% performed reformer exercises, used resistance bands, and selected pain and range of motion as outcome measures.** CONCLUSIONS **Pilates, although a popular exercise method, does not seem to be recommended for AT rehabilitation. Given that exercise is the most effective intervention and that the holistic and individualized approach to rehabilitation is proposed, well-designed studies could set the principles for the utilization of another popular and accessible exercise approach.**

ARCHIVES OF HELLENIC MEDICINE 2026, 43(2):212–220
ΑΡΧΕΙΑ ΕΛΛΗΝΙΚΗΣ ΙΑΤΡΙΚΗΣ 2026, 43(2):212–220

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Διερεύνηση της εφαρμογής της μεθόδου πιλάτες στην αποκατάσταση της τενοντοπάθειας του Αχίλλειου τένοντα

Περίληψη στο τέλος του άρθρου

Key words

Achilles tendon
Pilates
Tendinopathy

Submitted 6.1.2025
Accepted 16.2.2025

Achilles tendinopathy (AT) is one of the most common tendinopathies of the lower extremities, the incidence of which has been estimated at 7–9% in the general population,[1] but can reach up to 50% in certain groups of athletes, such as runners.[2,3] The term "tendinopathy" is used to describe the spectrum of tendon pathology, from inflammation to degeneration.[4] It is essentially a clinical syndrome, which can appear in all tendons, but usually develops in the largest ones, such as the Achilles tendon, the patellar tendon, the rotator cuff tendon.[5,6]

Achilles tendinopathy is associated with a triad of symptoms, which include pain, swelling, and reduced functional capacity.[7] It has significant social impacts, such as loss of productivity at work and costs associated with treatment and rehabilitation, as symptoms may persist for five to ten years in some patients,[8] while high relapse rates have also been reported.[9]

Exercise remains today the cornerstone of Achilles tendinopathy rehabilitation, as it has been shown to significantly improve function and reduce pain. Eccentric exercise programs[10] or the combination of eccentric-concentric exercise,[11] as well as isometric exercise programs[12] are now widely applied in clinical practice.[7] Eccentric exercise shows positive short-term and long-term clinical results.[13] Alfredson's eccentric exercise program is the most commonly used protocol. The exercises are performed twice a day, for 12 weeks, with the aim of increasing the strength and functionality of the tendon.[10]

Another eccentric-concentric exercise protocol was described, with progressive loading of the tendon, while the exercises are adapted to include more complex movements, such as plyometric exercises. This 12-week program improves the clinical symptoms of AT just as effectively as eccentric exercise.[11,14,15]

Although these protocols remain effective in reducing symptoms and regaining the functional capacity of the AT, they have been criticized for some of their characteristics, such as the many repetitions of the exercises,[16] the high frequency of the exercises, their long duration, as well as the fact that the recommended exercise dosage (e.g. in the Alfredson protocol) may not be suitable for all patients.[17] In addition, studies of the experiences of patients who have participated in rehabilitation programs for AT report some negative views, such as that the exercise is time-consuming and difficult to implement given their busy lifestyles and that their recovery was slower than expected, while at the same time they emphasize the need for a bio-psychosocial approach to rehabilitation.[18,19]

In fact, researchers argue that various psychological factors, such as fear, the patient's assessment of pain, and the impact of tendinopathy on quality of life, may be just as influential –along with factors affecting healing– on patients' clinical characteristics with tendinopathy,[18,20] although the lack of randomized studies and studies with strong methodological frameworks in evaluating how psychosocial factors influence clinical outcomes in tendinopathy and more broadly in musculoskeletal disorders is highlighted.[21] In musculoskeletal disorders, the wider use of a bio-psychosocial model –for example in patient education– seems to offer more scope for optimal management and rehabilitation.[22,23] It is also suggested that various rehabilitation interventions based on both physical and psychological elements may have positive effects on outcome measures such as kinesiophobia, which is related to the avoidance of movement[24] and may negatively affect the outcome in tendinopathy.[25]

In the above context, alternative exercise approaches such as the Pilates method have begun to show research interest regarding their effectiveness in AT.[16] Pilates is a popular exercise method that focuses on breathing, centering, alignment, motor control, mindfulness offering an holistic approach.[26] These special characteristics make it suitable for rehabilitation in chronic musculoskeletal disorders.[27,28] The research on the Pilates method is focused on spine conditions, while there is research interest in the application of the method to the rehabilitation of the upper and lower limb injuries.[29–31] During the last decade, there has been research interest in the rehabilitation of tendinopathy[17,32] in an attempt to create implementation protocols for the population that has difficulty to follow and execute established yet demanding protocols.

Despite this, the degree of use of Pilates in clinical practice remains unknown, both in the Greek and in the international context, and the existing reports are isolated.[33–35] The lack of data on the application of Pilates in clinical practice limits its further utilization in the rehabilitation of other disorders such as AT, due to the absence of data on the most appropriate exercise protocols and their dosage. The purpose of this study is to investigate the application of Pilates exercises to AT in daily clinical practice and to determine the intensity, frequency and dosage of execution.

MATERIAL AND METHOD

Design and sample

A cross-sectional study was carried out, which followed the quantitative approach by administering an improvised questionnaire to a sample of physical therapists in Greece, in order to collect and analyze data regarding the use of the Pilates method in the rehabilitation of patients with musculoskeletal disorders, with an emphasis on AT. The research sample consisted of 45 physical therapists, members of the Panhellenic Association of Physical Therapists in Greece. The researcher contacted the Panhellenic Association of Physiotherapists in order to distribute the questionnaire on social media. In order to be able to participate in the research, physiotherapists had to have a professional license. The study did not exclude people who used the Pilates method, but were not certified instructors themselves.

Research instrument

Data was collected according to Standards for Reporting Qualitative Research checklist (SRQR) in order to ensure quality and transparency.[36] The questionnaire initially includes a section to collect participants' demographic information, including their job characteristics, such as field of expertise and current employment status. In the main part, the questions concern the management of patients with AT in clinical practice, the general use of Pilates in clinical practice, the use of Pilates in the rehabilitation of patients with AT and the dosage regarding the type(s) of exercises applied. The questions are multiple-choice, while in some cases open-ended questions were included in order to detect useful and sufficient information, through the thematic analysis of the results in three areas: the performance of the method, advantages and possible risks-complications.

Data collection method

The questionnaire was piloted with five physical therapists to check its content comprehensibility, identify possible errors and make any modifications. Musculoskeletal physiotherapists with many years of experience (at least five years) were selected, in order to distinguish possible deficiencies, while four of the five were certified instructors in the Pilates method and had extensive experience in its application to musculoskeletal disorders. After

the end of the pilot, the necessary changes were made, in terms of adding some more targeted questions, additional answers to some multiple-choice questions, as well as changing the answer format from "multiple-choice" to "open-ended". In general, and although the physiotherapists who participated in the pilot were trained from different schools, there was a consensus regarding the choice of Pilates exercises in small and large equipment, while in general a common way of thinking was found which was based on the holistic approach and the basic principles of Pilates.

After the completion of the pilot survey, the questionnaire was developed and distributed in electronic form through the Microsoft platform Forms. Online studies are disseminated and completed in a short period of time, have little or no cost, little chance of bias and guarantee the protection of personal data.[37] In the present research, the link of the questionnaire was sent by the researcher to the Panhellenic Association of Physiotherapists, which shared it on its social media accounts, so that it would be available to its members. The responses were collected between September 29 and October 27, 2023.

Ethical considerations

The study took into account all ethical procedures that govern the conduct of scientific studies. For the conduct and distribution of the questionnaire, permission was obtained from the Research Ethics and Ethics Committee of the University of Western Attica (ref no: 54554/6.6/2023). All physiotherapists participated in the study by giving their consent electronically. Participation was voluntary and anonymity was maintained, as at no point in the questionnaire were participants asked to fill in personal details or other sensitive personal data. Participants also had the opportunity to withdraw from the study at any time. All were informed about the above information in a short text that preceded the main part of the questionnaire. Response data was saved through the researcher's personal Microsoft account forms and access from external sources was protected through credentials.

Data analysis

IBM SPSS version 28 was used for the statistical analysis of data. Tables and frequency diagrams were used to summarize and present the results. Due to the small sample size, no inductive statistical tests were performed and the results are presented in a descriptive manner.

RESULTS

Sample demographics

A total of 45 physical therapists participated in the study. The survey response rate could not be calculated as it was conducted electronically. Therefore, it is not known how many members of the Panhellenic Association of Physiotherapists were exposed to the publication of the questionnaire.

Regarding the demographics of the physical therapists who answered the questionnaire, the sample consisted of 51.1% men and 48.9% women. In terms of age, the majority were 30–45 years old (42.2%) and graduated of higher education (53.3%). Most have been practicing their profession for more than 10 years (57.8%) and were specialized in musculoskeletal disorders (77.8%). Regarding the current professional situation, the majority were self-employed in their own physical therapy clinic (33.9%), although relatively similar were the percentages of those who were self-employed in-home treatments (28.6%) or worked in the private sector (23.2%) (tab. 1).

Table 1. Demographic characteristics of physical therapists (n=45).

Characteristics	n (%)
Gender	
Male	23 (51.1)
Female	22 (48.9)
Age (years)	
<30	12 (26.7)
30–45	19 (42.2)
46–55	13 (28.9)
>55	1 (2.2)
Years of physical therapist practice	
<2	3 (6.7)
2–5	8 (17.8)
6–10	8 (17.8)
>10	26 (57.8)
Level of education	
Graduate of higher education	24 (53.3)
Postgraduate degree	20 (44.4)
Post-doctoral title	1 (2.2)
Field of expertise	
Cardiorespiratory	2 (4.4)
Musculoskeletal	35 (77.8)
Neurologically	3 (6.7)
Other	5 (11.1)
Current professional status	
Employee in the public sector	8 (14.3)
Employee in the private sector	13 (23.2)
Self-employed in my own physical therapy clinic	19 (33.9)
Self-employed in-home remedies	16 (28.6)

Knowledge of Achilles tendinopathy and patient management in clinical practice

Regarding the physical therapists' knowledge of the conditions described by the term AT, a small part of the participants mistakenly believed that it included inflammation in the Achilles tendon (19.6%), and Achilles paratendinopathy (8.6%). Conditions classified as AT included, however, Achilles tendon pain, degeneration, mid-portion and insertional tendinopathy and were correctly identified by the majority of the sample.

Physical therapists managed patients with AT in their clinical practice, although the majority reported fewer than five patients per month (89.7%). Patients' age ranged 25–45 and the 69.2% were either amateur or professional athletes (tab. 2).

Regarding the types of exercise, the most frequently stated ones were eccentric exercises (42.1%), isometric combined with eccentric and concentric exercises (39.5%) and plyometric exercises (34.2%), although the majority of the sample (52.6%) stated a combination of all types of exercises. In addition to kinesiotherapy, physiotherapeutic intervention included a wide variety of electrotherapeutic (69.2%) and non-electrotherapeutic modalities, such as transverse massage (51.3%) and cryotherapy (51.3%).

Table 2. Distribution of responses to questions regarding the management of patients with Achilles tendinopathy (AT).

Management of patients with AT	n (%)
Treatment of a patient with tendinopathy of the Achilles tendon	
No	6 (13.3)
Yes	39 (86.7)
Total number of patients with AT seen per month	
<5	35 (89.7)
6–10	4 (10.3)
>10	0 (0.0)
Age group of patients with AT (years)	
15–25	9 (15.5)
26–35	19 (32.8)
36–45	18 (31.0)
46–60	12 (20.7)
>60	0 (0.0)
Population of patients with AT	
General population	12 (30.8)
Sports population (amateur-recreational sports)	27 (69.2)

Pilates in clinical practice and in Achilles tendinopathy rehabilitation

The use of Pilates in clinical practice, emerged that the majority were aware of the method (75.6%), but less than half (41.2%) used it in their daily clinical practice. 78.6% of physical therapists had received relevant training, while its use in the rehabilitation of patients with AT was limited to only nine participants.

Pilates parameters/dosage in Achilles tendinopathy rehabilitation

For the physical therapists who stated that they use Pilates in AT rehabilitation, data were gathered regarding the parameters and dosage of the exercise. The majority (77.8%) conducted two sessions per week, in all cases lasting 30 minutes, with the usual duration of rehabilitation being reported at three to six weeks (66.7%).

In addition, physical therapists reported that they performed about ten exercises per session (77.8%), 10 repetitions per exercise (77.8%). There were also exercises that they performed in repeated sets (55.6%), mainly in two sets (62.5%) with breaks between them (100.0%). 77.8% determined resistance with DeLorme or Oxford (tab. 3).

Regarding the choice of exercises, 77.2% of physical therapists stated that they performed mat exercises in various positions, exercises with large equipment, mainly Reformer (100.0%) and Cadillac (50.0%) and exercises with small equipment, such as therabands (100.0%) and small balls (55.6%). Also, their exercise program included exercises in the biokinetic chain (66.7%) and less exclusively in the affected lower limb (33.3%) while trunk exercises were performed by the vast majority (88.9%).

The exercises that the physical therapists perform at Reformer were mainly walking, footwork plies, toes parallel and single leg heels, while most apply exercises with all the resistance provided in the reformer at a slow pace (77.8%).

At Cadillac they mainly use foot work parallel toes, walking and a combination of all the exercises listed for them. In both Reformer and Cadillac, the majority of physical therapists used heels as a stretching exercise (77.8%), as well as the Jumpboard as a plyometric exercise (77.8%).

Finally, participants were asked about the outcome measures. Pain (5/9) and range of motion (3/9) were the most frequently reported, while exercise performance, swelling, endurance, strength, single leg hop, the single leg calf raise and the royal London hospital test were referred. Physical therapists did not report using questionnaires to

Table 3. Information on the dosage of Pilates in the rehabilitation of patients with Achilles tendinopathy.

Pilates in clinical practice	n (%)
Number of exercises during a session	
10	7 (77.8)
10–20	2 (22.2)
>20	0 (0.0)
Repetitions	
10	7 (77.8)
>10	2 (22.2)
Exercises in repeated sets	
Yes	5 (55.6)
No	1 (11.1)
Sometimes	3 (33.3)
Number of sets	
2	5 (62.5)
>2	3 (37.5)
Break between sets	
Yes	9 (100.0)
No	0 (0.0)
DeLorme or Oxford protocols	
Yes	7 (77.8)
No	2 (22.2)

assess outcome measures. Only two participants reported assessing patient satisfaction with treatment; one of them reported using his own questionnaire.

DISCUSSION

The paper studied the application of Pilates in the rehabilitation of patients with AT, as reflected in the clinical practice of 45 Greek physiotherapists. Only one in five physiotherapists reported using Pilates in the rehabilitation of patients with AT, seeing fewer than five patients per month, although the majority were familiar with it and had received training. In contrast, the use of traditional rehabilitation methods was widespread, including eccentric exercise and a combination of concentric-eccentric-isometric exercises.

This was not surprising, as the benefits of these approaches in rehabilitation are widely documented in the literature.[38–44] Specifically, eccentric exercise is the cornerstone of conservative treatment for AT and is widely used as a first-line treatment, as it has been shown to promote collagen fiber formation,[45] thus facilitating its remodeling and improving its functional capacity.[46] Isometric exercise programs, concentric exercise,[12,47] and high-resistance exercises performed at a slow pace also show high levels of effectiveness in the rehabilitation of patients with AT.[48] Our findings regarding the widespread use of eccentric exercise in the rehabilitation of AT are consistent with findings from a previous study conducted with an international sample of physiotherapists.[49] Although there is no single therapeutic protocol based on the literature, the Alfredson protocol is widely used, as it is recommended in clinical guidelines.[50,51]

However, conservative rehabilitation methods come with limitations, which have been highlighted in studies from the experiences of patients and physiotherapists, such as low motivation,[49] perceived lack of short-term treatment effectiveness, patients' belief that exercise may worsen their symptoms, the long duration of rehabilitation,[18] low levels of adherence,[52] and the influence of various psychological and cognitive factors on clinical outcomes.[53] There is also a noted lack of understanding among physiotherapists regarding the terminology of AT, which may lead to inadequate clinical management in rehabilitation,[54] a finding that is confirmed in the present study.

In this context, during recent years, researchers have proposed alternative exercise approaches –without dismissing traditional and well-documented methods– arguing that they can meet the current needs of individual patients and yield clinically positive outcomes,[32,55] including Pilates.[56] Previous research has shown that patients with musculoskeletal disorders who received Pilates in their rehabilitation rated their experience positively and showed improvements in pain, disability, and functionality measures.[57–59] Today, the Pilates method is practiced as an alternative rehabilitation method,[33,35] although its acceptance is not widespread, possibly due to concerns about the lack of physiotherapists' training,[60] or due to a lack of studies regarding the optimal parameters for prescribing exercise to different populations of individuals with musculoskeletal disorders or other conditions,[57] issues also highlighted in the present study.

Initially, the training and certification of physiotherapists in the Pilates method is necessary. Organizations and institutions in various countries, such as the Pilates Method Alliance (PMA) in the USA and the Australian Physiotherapy and Pilates Institute (APPI) in Australia and the UK, provide certification that is widely recognized and includes strict practice guidelines.[61] The need for training and certification of physiotherapists in the Pilates method is linked to its adoption as a rehabilitation method in national health systems, such as the National Health Service (NHS) in the

UK, where Pilates is used in the rehabilitation of musculoskeletal and neurological disorders.[57,58,62]

In the present study, while the majority of physiotherapists had received training in the Pilates method, few used it in their daily clinical practice, and even fewer reported using it in the rehabilitation of patients with AT. While the reasons for the lack of Pilates adoption in physiotherapists' clinical practice in Greece are unclear, it could be hypothesized that this is due to the lack of studies regarding the optimal dosage/parameters for prescribing exercise or the lack of application guidelines for different categories of conditions, including musculoskeletal ones.[57]

In this study, the physiotherapists who used Pilates in the rehabilitation of AT primarily conducted two sessions per week, each lasting 30 minutes. There are no similar studies in the literature evaluating the practical application of Pilates in AT, limiting the comparability of our findings. However, studies on patients with other musculoskeletal disorders suggest, in agreement with our findings, that two sessions per week are recommended for optimal results in pain and disability.[60,63] Two sessions per week are also recommended[64] in the literature, while in a scoping review it is stated that most rehabilitation programs applied to patients with musculoskeletal disorders included two to three sessions per week.[17]

A difference is also observed in other parameters of Pilates dosage. In this study, the most frequently reported session duration –by the Greek physiotherapists– was 30 minutes, while the shortest recovery time was three to six weeks, as reported by the majority of the sample. The session duration ranges from 30–60 minutes in studies involving patients with musculoskeletal disorders in athletes and the general population, with each study showing improvements in outcome measures such as pain, disability, movement control, and strength.[65,66] The optimal Pilates dosage parameters have mainly been studied in patients with chronic musculoskeletal conditions, who have a different symptom profile compared to AT, thus limiting the comparability of our findings.

Regarding the type of exercises, this study found a variety of approaches followed by physiotherapists in rehabilitation, such as mat exercises, exercises with large equipment –mainly Reformer and Cadillac– and exercises with smaller equipment. These findings align with those of an earlier study on Australian physiotherapists.[64] The use of Pilates equipment in rehabilitation has also been reported in randomized controlled trials, which demonstrate positive outcomes in measures such as functional capacity and patient satisfaction with the Pilates program.[67,68]

Looking at the data from this study regarding the application of Pilates in the rehabilitation of AT, it is observed that a typical exercise protocol lasts from three to six weeks, with two sessions per week lasting 30 minutes each. In each session, ten exercises are performed in repeated sets with breaks between sets. Mat exercises with small equipment (resistance bands, balls) in various positions, as well as exercises with large equipment (Reformer and Cadillac) are performed.

The findings of the present study regarding the application of Pilates in the rehabilitation of AT were based on responses from nine physiotherapists and, therefore, cannot be generalized. It is also not known whether the sample is representative of the population, and therefore it cannot be assessed to what extent it reflects the current practical application of the Pilates method in the rehabilitation of AT. This factor also limits our ability to conduct inductive statistical analyses, as does the fact that the majority of the physiotherapists providing information on the use of Pilates in the rehabilitation of AT reported mainly managing patients from the athletic population. Overall, given all the above limitations, our findings require verification in future research.

In conclusion, this is the first study conducted in Greece regarding the application of the Pilates method by physiotherapists in the rehabilitation of tendinopathy, specifically AT. Pilates does not seem to be a preferred form of exercise in the rehabilitation of AT. Given that exercise is the most effective intervention, as well as the recommended holistic and individualized approach to rehabilitation, well-designed studies could provide the framework for leveraging such a popular and accessible exercise.

ΠΕΡΙΛΗΨΗ

Διερεύνηση της εφαρμογής της μεθόδου πιλάτες στην αποκατάσταση της τενοντοπάθειας του Αχίλλειου τένοντα

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ΣΚΟΠΟΣ Διερεύνηση της εφαρμογής του θεραπευτικού-κλινικού πιλάτες στην καθημερινή κλινική πράξη και προσδιορισμός της έντασης, της συχνότητας και της δοσολογίας εκτέλεσης στην Αχίλλειο τενοντοπάθεια (ΑΤ). **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Εκπονήθηκε μια συγχρονική μελέτη που ακολούθησε την ποσοτική προσέγγιση με τη χορήγηση ενός αυτοσχεδιασμένου ερωτηματολογίου σε δείγμα φυσικοθεραπευτών στην Ελλάδα προκειμένου να συλλεχθούν και να αναλυθούν στοιχεία σχετικά με τη χρήση της μεθόδου πιλάτες στην αποκατάσταση και να διερευνηθεί η χρήση της στην ΑΤ, να προσδιοριστεί το ασκησιολόγιο, η ένταση και η συχνότητα εκτέλεσης, καθώς και η δοσολογία. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Από τους 45 φυσικοθεραπευτές που απάντησαν στο ερωτηματολόγιο, η πλειοψηφία (75,6%) γνώριζε τη μέθοδο. Ένα ποσοστό 41,2% την εφάρμοζε στην καθημερινή κλινική πρακτική, 78,6% είχε λάβει σχετική εκπαίδευση και μόλις 9 από αυτούς την εφάρμοζαν στην αποκατάσταση της ΑΤ. Η πλειοψηφία αυτών εκτελεί δύο συνεδρίες την εβδομάδα για 3–6 εβδομάδες, 10 ασκήσεις των 10 επαναλήψεων σε επαναλαμβανόμενα sets με διάλειμμα. Το 100% εκτελεί ασκήσεις στο reformer, χρησιμοποιεί λάστιχα αντίστασης και επιλέγει τον πόνο και το εύρος κίνησης ως μέτρα έκβασης. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Το πιλάτες, παρ' όλο που αποτελεί μια δημοφιλή μέθοδο άσκησης, δεν φαίνεται να είναι προτεινόμενη στην αποκατάσταση της ΑΤ. Δεδομένης της τεκμηριωμένης θέσης ότι η άσκηση συνιστά την αποτελεσματικότερη παρέμβαση, καθώς και της ολιστικής και εξατομικευμένης προσέγγισης που προτείνεται στην αποκατάσταση, καλοσχεδιασμένες μελέτες θα μπορούσαν να θέσουν τη βάση για την αξιοποίηση μιας ακόμη δημοφιλούς και προσιτής προσέγγισης άσκησης.

Λέξεις ευρετηρίου: Αχίλλειος τένοντας, Πιλάτες, Τενοντοπάθεια

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