The effect of dose components on resistance exercise therapies for tendinopathy management: A systematic review and meta-analysis

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Abstract

Objective: To investigate potential moderating effects of resistance exercise dose components including intensity, volume and frequency, for the management of common tendinopathies.

Design: Systematic review and meta-analysis comprising an extensive search of databases and trial registries.

Eligibility criteria for selecting studies: Randomised and non-randomised controlled trials investigating resistance exercise as the dominant treatment class and reporting sufficient information regarding at least two components of exercise dose (intensity, frequency, volume).

Methods: Non-controlled standardised mean difference effect sizes were calculated across a range out outcome domains and combined with Bayesian hierarchical meta-analysis models for domains generating large (disability; function; pain) and small (range of motion; physical function capacity; and quality of life) effect size values. Meta-regressions were used to estimate differences in pooled mean values across categorical variables quantifying intensity, frequency and volume.

Results: Ninety-one studies presented sufficient data to be included in meta-analyses, comprising 126 treatment arms (TAs) and 2965 participants. Studies reported on five tendinopathy locations (Achilles: 39 TAs, 31.0%; rotator cuff: 39 TAs, 31.0%; lateral elbow: 25 TAs, 19.8%; patellar: 19 TAs, 15.1%; and gluteal: 4 TAs, 3.2%). Meta-regressions provided consistent evidence of greater pooled mean effect sizes for higher intensity therapies comprising additional external resistance compared to body mass only (large effect size domains: $\beta_{\text{BodyMass:External}}$ =0.39 [95%CrI: 0.00 to 0.82; p = 0.976]; small effect size domains ($\beta_{\text{BodyMass:External}}$ =0.09 [95%CrI: -0.20 to 0.37; p = 0.723]) when data were combined across tendinopathy locations or analysed separately. Consistent evidence of greater pooled mean effect sizes was also identified for the lowest frequency (less than daily) compared with mid (daily) and high frequencies (more than daily) for both large effect size domain ($\beta_{<Daily:Daily}$ = -0.66

[95%CrI: -1.2 to -0.19; p >0.999]; $\beta_{<Daily:>Daily}$ = -0.54 [95%CrI:-0.99 to -0.10; p >0.999]) and small effect size domains ($\beta_{<Daily:Daily}$ = -0.51 [95%CrI: -0.78 to -0.24; p >0.999]; $\beta_{<Daily:Daily}$ = -0.34 [95%CrI: -0.60 to -0.06; p = 0.992]) when data were combined across tendinopathy locations or analysed separately. Minimal and inconsistent evidence was obtained for differences for a moderating effect of training volume.

Summary/Conclusion: Resistance exercise dose is poorly reported within the tendinopathy management literature. However, this large meta-analysis identified some consistent patterns indicating greater efficacy on average with therapies prescribing higher intensities (through the inclusion of additional external loads) and lower frequencies, potentially creating stronger stimuli and facilitating adequate recovery.

Introduction

Tendinopathy is a prevalent musculoskeletal condition involving degenerative changes within tendons of both children and adults (1). It occurs in athletic and non-athletic individuals (2) and can manifest in persistent pain (3,4), swelling (1), loss of function, and diminished movement (5). Although tendinopathy can occur in any of the six hundred or more tendons in the body, the most common sites for tendinopathy include the Achilles, rotator cuff, lateral elbow, patellar and hip tendons (1). Exercise therapy is the mainstay of conservative management of tendinopathy and has focused largely on resistance exercise and in many instances, eccentric actions (6). The objective with exercise therapy is to encourage load tolerance that leads to structural adaptations at the musculotendinous unit and restores function (7,8). The effectiveness of exercise therapy is likely to be influenced not only by the specific exercises performed but also the magnitude of the stimulus quantified by the concept of exercise dose (9). At the most basic level in clinical settings, exercise dose comprises three variables including frequency, duration, and intensity, with overall exercise dose quantified as the product of all three variables (10). As evidence has continued to grow and establish the potential effectiveness of exercise therapies across a range of populations and tendinopathies, it has been recommended that both primary research and evidence synthesis studies attempt to better quantify dose-response relationships (9,11,12).

The potential to quantify dose-response relationships for exercise therapy and the management of tendinopathy may be most feasible when comprising resistance exercise due to the amount of data available and the ability to appropriately quantify dose variables including intensity. Many resistance interventions for upper limb tendinopathies begin by using the weight of a limb to provide light resistance before increasing intensity and progressing to adding external resistance sources (13,14). Upper limb tendinopathies also frequently use TheraBands or dumbbells to provide resistance, for example internal/external rotations resisted with a TheraBand (15) for shoulder impingement syndrome or dumbbell weighted writs curls (14), often progressing from one to the next. In contrast, resistance exercises for lower limb tendinopathies commonly involve body mass exercises such as eccentric squats for patellar tendinopathy (16) or eccentric heel drops for Achilles tendinopathy (17). Progressions to external resistance sources frequently involve the addition of mass using loaded backpacks where exercise is performed in home environments (18,19), or with a percentage of the maximum load that can be lifted where exercise is performed in a gym environment (20-22).

Exercise volume is commonly described in terms of the number of sets and/or repetitions (sets*reps) of the primary resistance exercises, although other reporting methods such as the overall duration of sessions can be used (23,24). Exercise volume may exhibit large variations, with combinations generally including 2-3 sets of 5-15 repetitions (15,25,26). However, higher volume therapies are also frequently used in popular approaches such as the Alfredson method for the treatment of Achilles tendinopathy (27) where the total number of repetitions can be as high as 180 per day (28). Exercise frequency is also known to vary considerably across resistance exercise therapies, with inverse relationships expected such that those including the highest intensities will exhibit the lowest frequencies (9).

Initial attempts to synthesise evidence and identify dose-response relationships for exercise therapy in tendinopathy management have been limited by setting restrictive inclusion criteria and substantially reducing the amount of data available. Meyer et al. (12) only included three studies when investigating the effect of eccentric exercise protocols for Achilles tendinopathy. In a similar follow-up review, the number of included studies was increased to eight (29), however, the authors still concluded that heterogenous outcomes and methodological limitations meant that data could not be pooled, nor recommendations made regarding dose-response. An alternative strategy in evidence synthesis is to increase the amount of data available by combining heterogenous sources and exploring the variability in results. For example, Young et al. (9) increased the amount of data available by including research studies investigating multiple common disorders. The systematic review and meta-analysis included eighteen studies investigating Achilles tendinopathy, ankle sprains and planar heel pain. Several trends were identified by Young et al. (9) including greater effects with increased frequency and progressive exercise compared with pre-prescribed sets and repetitions. However, no formal statistical comparisons of exercise dose were made limiting the conclusions that can be drawn. Given the limited amount of research that has attempted to explore dose-response relationships across the wider exercise therapy and tendinopathy literature, the present systematic review and meta-analysis was conducted and combined data from studies investigating the effectiveness of resistance exercise across the most prevalent tendinopathies (RCRSP, lateral elbow, patellar or Achilles). The present study sought to use contemporary meta-analysis and meta-regression approaches to explore the heterogeneity and assess for general trends regarding dose-response relationships.

Methods

Inclusion criteria

This review was part of a project funded by the National Institute for Health Research (NIHR) [Health Technology Assessment (HTA) 129388 Exercise therapy for the treatment of tendinopathies]. The review adhered to an *a priori* protocol (PROSPERO 2020 CRD42020168187) with the inclusion criteria and methods influenced by the project aims, the results of our initial scoping review mapping the exercise and tendinopathy literature as well as stakeholder workshops.

Participants

This meta-analysis included people of any age or gender with a diagnosis of RCRSP, lateral elbow, patellar, Achilles or gluteal tendinopathy of any severity or duration. Studies involving participants with tendinopathy in the absence of full thickness or large tears were also included. The trial authors' diagnoses were accepted where a clearly verifiable group of clinical features is reported including: pathognomonic location of pain; a symptom altering response to applied load and/or stretch, with there being a specific test for most tendinopathies; strategies to rule out differential diagnoses; ultrasound or magnetic resonance imaging confirmation of structural change. Data from studies with mixed groups were included where there was clear reporting of the tendinopathic group, or they made up > 90% of the investigated cohort.

Intervention

The health technology being assessed was exercise therapy that where resistance exercise represented the dominant class (see supplementary file SF1 for definitions). Interventions combining exercise with other non-exercise therapies (e.g. laser, shockwave, manual therapy or injection) were not included. We included resistance exercise delivered in a range of settings (e.g. primary care, secondary care, community, people's homes) by a range of health or exercise professionals (e.g. physiotherapists, strength & conditioning coaches, personal trainers) or support workers, as well as supervised or unsupervised exercise (i.e. self-management). Included studies were required to report sufficient information regarding the resistance exercise dose, including frequency (defined as the number of training sessions performed per week), volume (defined as the total number of repetitions (sets × repetitions), and intensity (limb/bodyweight versus additional external load expressed in absolute or relative terms). Where sufficient information was not presented in the main text of a study to quantify all three dose variables, the publishers' website was searched to check for relevant information in any supplementary files. Studies were only included if a minimum of two of three dose components could be quantified.

Comparator

No head-to-head comparators were included, and analyses were conducted across levels of the dose moderator variables.

Outcomes

Based on the results of our initial reviews (30,31) and stakeholder workshops we included outcomes that assessed six domains including: 1) disability; 2) function; 3) pain (e.g. pain on loading, pain over a specified time, pain without further specification); 4) range of motion for shoulder joint; 5) physical function capacity; and 6) quality of life. Definitions of each domain and example tools are presented in SF2.

Types of studies

We included randomized controlled trials and non-randomized controlled trials where at least one intervention arm comprised an exercise therapy where resistance exercise was judged to be the dominant treatment class based on the composition of the therapy.

Context

The context included primary care, secondary care or community locations in nations defined as very high or high on the Human Development Index (top 62 countries at the time of protocol development) for the findings to be relevant to the UK context.

Search strategy

The search strategy used for this study was part of a larger search conducted to scope the entire tendinopathy and exercise therapy research base. We employed a three-step search strategy. Firstly, a limited search of MEDLINE and CINAHL using initial keywords (MH tendinopathy OR TX tendin* OR TX tendon*) AND (MH exercise OR TX exercis*) was conducted with analysis of the text words in the titles/abstracts and those used to describe articles to develop a full search strategy. Secondly, the full search strategy was adapted to each database and applied systematically to: MEDLINE, CINAHL, AMED, EMBase, SPORTDiscus, Cochrane library (Controlled trials, Systematic reviews), JBI Evidence Synthesis, PEDRo, and Epistemonikos (a full search strategy for MEDLINE is presented in SF3). The following trial registries were also searched: ClinicalTrials.gov, ISRCTN Registry, The Research Registry, EU-CTR (European Union Clinical Trials Registry), ANZCTR (Australia and New Zealand Clinical Trials Registry). Finally, the third step involved conducting a search of cited and citing articles using Scopus and hand-searching a total of 130 systematic reviews that were identified to include information relevant to exercise therapy and tendinopathy. No limit was placed on language, with research studies published in languages other than English translated via Google Translate or via international collaborations of the review team members. Searches were initiated from 1998 as (i) the heavy load eccentric calf-training protocol for Achilles tendinosis by Alfredson et al [46] was published in 1998 and may be considered seminal work in the field of tendinopathy, and (ii) there has been a proliferation of research on exercise interventions for tendinopathies post 1998. The final date of the search was 21/01/21.

Study Selection

Proquest® Refworks was used to manage references and remove duplicates, before importing to Covidence (Melbourne, Australia) to facilitate screening and further de-duplication. Each title and abstract underwent independent review by two members of the research team (PS/KC/LA/RM/LG/EP/JS/AP). Full-text copies of all studies included at title and abstract screening stage were retrieved and also screened independently by two members of the research team. Conflicts were resolved by discussion or by input from a third reviewer.

Data Extraction

Data were extracted independently by 8 members of the review team (PS/KC/LA/RM/LG/EP/JS/AP) into pre-piloted excel spreadsheets and independently coded as described in the accompanying extraction codebook (SF4). Each entry on the spreadsheet was double checked by a different member of the team. Where pre-post intervention data were not presented in text but in figures, data were extracted using PlotDigitizer 2.6.8 Windows (WebPlotDigitizer - Copyright 2010-2021 Ankit Rohatgi (automeris.io))

Risk of bias assessment

The risk of bias was assessed using a combination of the Cochrane Risk of Bias Tool (32) and RobotReviewer, a machine learning software that semi-automates the Cochrane tool. The Cochrane Risk of Bias Tool comprised the following seven domains: 1) random sequence generation; 2) allocation concealment; 3) blinding of participants and personnel; 4) blinding of outcome assessment; 5) incomplete outcome data; 6) selective reporting; and 7) other bias. A judgement of risk of bias was made for each domain and reported as either 'low risk', 'high risk' or uncertain' when there was insufficient detail in reporting or the outcome was not addressed. RobotReviewer was used to make initial assessments on domains 1,2 and 3 and validated manually using the extracted free text to agree on a final selection of low, high, or unclear risk of bias. This semi-automated process provided greater efficiency and consistency during the review process. A single assessment was made by individual members of the team with comments made to justify scoring and regular consultation between team members where uncertainties arose.

Confidence in cumulative evidence

Assessments were made using the Grading of Recommendations Assessment Development and Evaluation (GRADE) guidelines (33,34) in addition to recommendations on transparent reporting of evidence for tendinopathy management (35). Confidence in evidence was assessed at the outcome level with 1) overall risk of bias ranked as high, low or unclear risk, as identified by the mode rating across all data in the specific analysis; 2) inconsistency assessed based on meta-analysis results and comparisons of central and variance parameter estimates; 3) imprecision judged by the number of available data points (studies, treatment arms, outcome measures) and the width of credible intervals for central estimates; 4) indirectness identified as low risk for all outcomes based on inclusion criteria from our previous scoping review and stakeholder recommendation; and 5) small study effects assessed by visual inspection of effect size distribution and sampling variance. Overall confidence in evidence for each analysis was recorded as either high, moderate, low, or very low. Categorisations began with high confidence in cumulative evidence and were downgraded a level for each domain not judged as low risk.

Coding of resistance exercise therapies

Attempts were made to code exercise dose components (intensity, volume and frequency) for each study, however, sufficient information was not always available to code all three components. Coding of exercise intensity was initially achieved by identifying whether exercise load was prescribed in absolute (e.g. kilograms when using dumbbells or isoinertial loads) or relative terms (as a percentage of the maximum load that can be lifted) and the magnitude of the load recorded. Additionally, a binary coding was used to identify whether exercise was performed with body mass only (e.g. whole body mass or mass of a limb), or with the addition of external loads (such as a loaded backpack, dumbbell, or elastic resistance). Exercise volume was coded by quantifying the number of sets and repetitions. Exercise frequency was recorded as the total number of resistance exercise sessions performed per week (including where there were multiple sessions a day). In cases where several resistance exercises were prescribed, intensity and volume were extracted for the primary resistance exercise only.

Statistical analysis

The purpose of the meta-analysis was to investigate responses to exercise therapies where resistance exercise was the dominant treatment class. A broad modelling perspective was selected where outcomes across a range of tendinopathies and outcome domains were combined to investigate whether central estimates (e.g. pooled mean) were associated with different levels of moderator variables representing exercise dose (frequency, intensity or volume). Due to the use of different outcome domains and different tests within the same outcome domain, pooling of data required standardisation. This was achieved using the standardised mean difference (SMD_{pre}) effect size, dividing the mean group change by the pre-intervention standard deviation. Where baseline standard deviation values were not presented these were estimated using statistical information presented (36) (e.g. confidence intervals, standard errors, t values, P values, F values) or imputed through simple linear regression of the log-transformed standard deviations and means from studies included in the same analysis (37). Where required, SMD_{pre} values were reflected by multiplying by –1 to ensure that positive values represented an improved clinical effect. Where multiple outcomes were reported from the same study (different outcomes and/or the same outcome at multiple time points), all possible SMD_{pre} values were calculated and included in the meta-analysis models. To account for covariances created, all meta-analyses were conducted using a nested four-level model (38) comprising the individual study (level 4), the outcome (level 3), the measurement occasion (level 2), and the sampling variance (level 1) levels. The relative contributions of variance sources were described by variance partition coefficients (VPCs) calculated by dividing each estimated variance level by the total sum. Meta-analyses were conducted within a Bayesian framework providing additional flexibility in the handling of within study variances and enabled model estimates to be interpreted more intuitively through reporting of subjective probabilities (39).

To assess the effects of dose variables, meta-regressions were performed with intensity (body mass vs. additional external) and volume (lower volume: <45 repetitions vs. ≥ 45 repetitions) comprising binary categorisations, and frequency (< once per day vs. once per day vs. > once per day) comprising a trinary categorisation. Meta-regressions were presented by selecting one level of the variable as a reference to make comparisons ($\beta_{Reference:Comparison}$ = Median [95%CrI: LB to UB], such that $\beta>0$ indicates an increased effect of the comparison relative to the reference). Based on previous analyses with a similar data set showing large differences in effect sizes across outcome types, separate meta-regressions were performed for outcomes typically generating large effect sizes (disability, function and pain), and small effect sizes (physical function capacity, range of motion and quality of life). It was determined *a priori* that meta-regressions would only be performed when each level of the variable comprised a minimum of ten effect sizes from at least two studies. Inferences from all analyses were performed on posterior samples generated by Markov Chain Monte Carlo simulations and through use of credible intervals and calculated probabilities. Weakly informative Student-t prior and half-t priors with 3 degrees of freedom and scale parameter equal were used for intercept and variance parameters (40). Convergence of parameter estimates were obtained for all models with Gelman-Rubin R-hat values below 1.1 (41). Analyses were performed using the R wrapper package brms interfaced with Stan to perform sampling (42).

Results

Study selection

The search strategy identified a total of 9246 potential studies, with 4611 remaining following removal of duplicates (Figure 1). After title and abstract screening 4210 studies were removed leaving 425 studies obtained for full text screening. Of these studies, a further 334 were excluded based primarily on insufficient description of the exercise stimulus (116 studies) and not including exercise-only treatment arms (79 studies) or with resistance exercise as the dominant class (25 studies). In total, data from 91 studies comprising 126 treatment arms and 2965 participants were included in the meta-analyses (SF-5: Table of included studies and reference list). Exercise therapies for the treatment of five different tendinopathies (Achilles: 39 (31.0%) treatment arms; RCRSP: 39 (31.0%) treatment arms; lateral elbow: 25 (19.8%) treatment arms; patellar: 19 (15.1%) treatment arms; and gluteal: 4 (3.2%) treatment arms) were identified (Table 1). Over half of the treatment arms (69/54.8%) comprised resistance only therapies, with the remaining predominantly including additional flexibility exercises (Table 1). The dominant resistance exercise treatments are presented in table 1, with eccentric only exercise the most common for Achilles (79.5% of relevant treatment arms), lateral elbow (60% of relevant treatment arms) and patellar (47.4% of relevant treatment arms) tendinopathies; and both concentric and eccentric resistance exercise most common for gluteal (75% of relevant treatment arms) and RCRSP (66.7% of relevant treatment arms). Overall, eccentric-only (62 treatment arms) was the most common dominant treatment, followed by concentric and eccentric (41 treatment arms) then isometric (15 treatment arms).

Confidence in cumulative evidence

Risk of Bias and confidence in evidence assessments are presented for the primary meta-analyses and more broadly in supplementary files (SF6). In general, confidence in evidence was frequently low based on imprecision due to wide credible intervals and inconsistency due to large between study variance estimates. Overall confidence in cumulative evidence varied from very-low to moderate with low confidence most commonly identified.

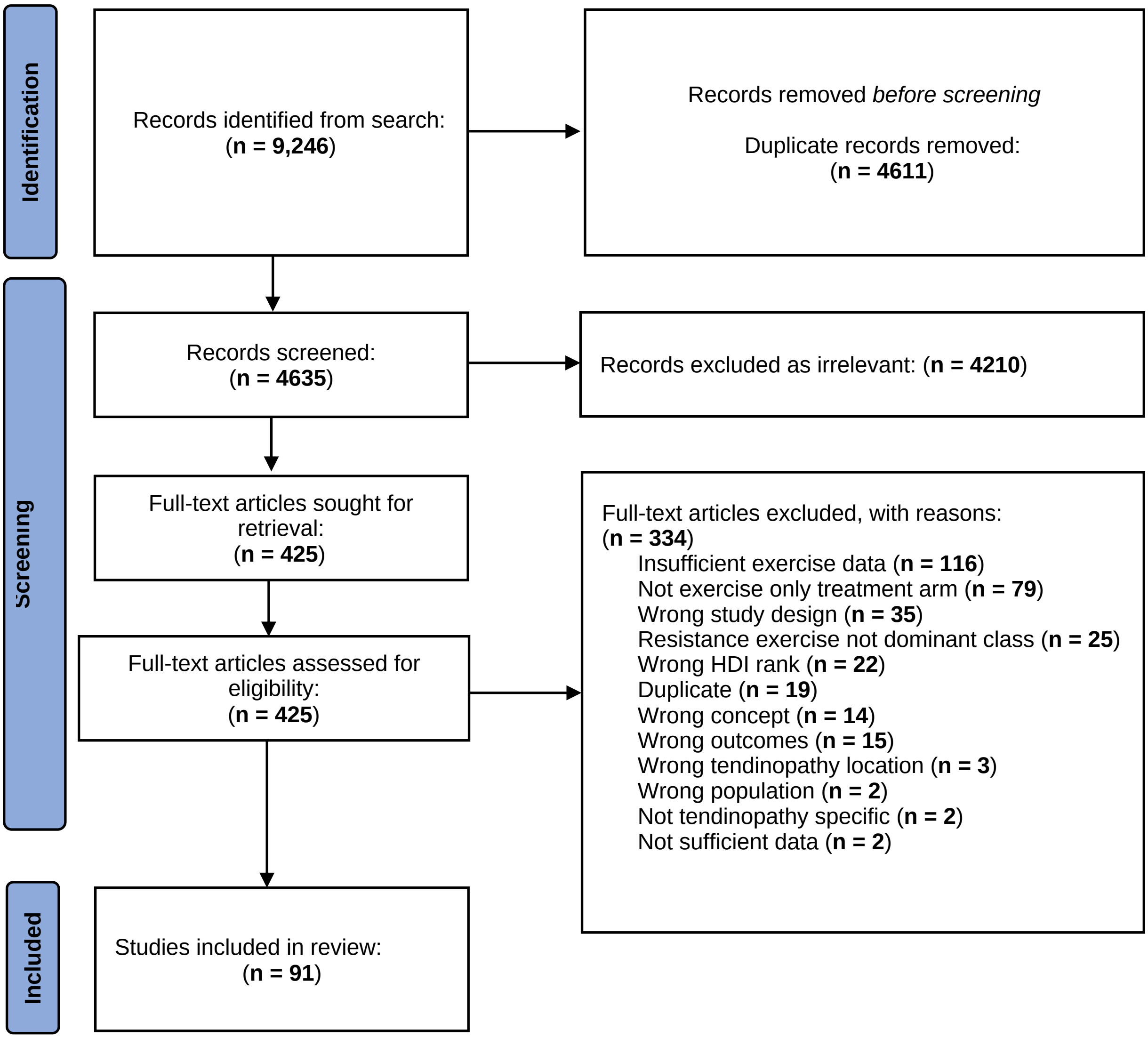

Figure 1: PRISMA Flow chart of study selection process.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

Table 1. Dominant resistance exercise treatments presented according to tendinopathy type

Tendinopathy Type	Resistance exercise treatment	Number (%) of treatment arms
Achilles	Eccentric only	31 (79.5%)
	Concentric and eccentric	5 (12.8%)
	Concentric only	2 (5.1%)
	Isometric	1 (2.6%)
Gluteal (including GTPS)	Concentric and eccentric	3 (75.0%)
	Isokinetic	1 (25.0%)
Lateral elbow	Eccentric only	15 (60.0%)
	Isometric	5 (20.0%)
	Concentric and eccentric	3 (12.0%)
	Concentric only	2 (8.0%)
Patellar	Eccentric only	9 (47.4%)
	Isometric	5 (26.3%)
	Concentric and eccentric	4 (21.1%)
	Concentric only	1 (5.3%)
Rotator Cuff-Related Shoulder Pain (RCRSP)	Concentric and eccentric	26 (66.7%)
	Eccentric only	7 (17.9%)
	Isometric	4 (10.3%)
	Concentric only	1 (2.6%)
	Isokinetic	1 (2.6%)

GTPS = greater trochanteric pain syndrome

Resistance exercise intensity

Of the 126 treatment arms included, 119 provided sufficient information to categorise the intensity as lower intensity in the form of body mass only (38 treatment arms; 32%), or higher intensity with the addition of external resistance (81 treatment arms; 68%) prescribed based on absolute loads (e.g. addition of weights to a backpack, isoinertial loads, TheraBand's and dumbbells), or percentage of a maximum. Meta-regressions provided consistent evidence of greater pooled mean effect sizes for increased training intensity with the addition of external loads. Primary meta-analyses pooling data across all tendinopathy locations identified an increase of $\beta_{\text{BodyMass:External}}$ =0.39 [95%CrI: 0.00 to 0.82; p = 0.976] for outcomes generating large effect sizes, and an increase of $\beta_{\text{BodyMass:External}}$ =0.09 [95%CrI: -0.20 to 0.37; p = 0.723] for outcomes generating small effect sizes (Table 2). Similarly, point estimates indicated greater pooled mean values for the addition of external resistance for all analyses separated by tendinopathy location for which there was sufficient data (Supplementary file SF7a).

Frequency of resistance exercise

Of the 126 treatment arms included, 118 provided sufficient information to categorise the frequency as low frequency (less than daily: 39 treatment arms; 33%), moderate frequency (daily: 30 treatment arms; 25%), or high frequency (more than daily: 49 treatment arms; 42%). Consistent evidence of a moderating effect was also identified for resistance exercise frequency with greater pooled mean effect sizes identified for the lowest frequency of less than once per day. Primary meta-analyses pooling data across all tendinopathy locations identified median increases of $\beta_{<Daily:Daily}$ = -0.66 [95%CrI: -1.2 to -0.19; p >0.999] between less than once per day and once per day, and $\beta_{<Daily:>Daily}$ = -0.54 [95%CrI:-0.99 to -0.10; p >0.999] between less than once per day and more than once per day for outcomes generating large effect sizes. Similarly, median increases of $\beta_{<Daily:Daily}$ = -0.51 [95%CrI: -0.78 to -0.24; p >0.999] and $\beta_{<Daily:Daily}$ = -0.34 [95%CrI: -0.60 to -0.06; p = 0.992] were identified across the comparisons for outcomes generating small effect sizes (Table 3). Consistent evidence of increased pooled mean effect sizes for resistance exercise performed less than once per day was also obtained when analyses were separated by tendinopathy location (Supplementary file SF7b). In contrast, effect size estimates tended to be similar for exercising once per day or more than once per day (Table 3) with wide overlap of potential values also identified when analyses were separated by tendinopathy location (Supplementary file SF7b).

Resistance exercise volume

Resistance exercise volume was categorised for 114 treatment arms as the product of the number of sets and repetitions for the primary resistance exercise. The most common number of total repetitions was 45 (e.g. 3 sets of 15 repetitions) and this accounted for almost half of the training interventions (51 treatment arms; 45%). As a result, training volume was coded as a binary variable characterised as lower volume (<45 total repetitions: 55 treatment arms; 48%) and higher volume (≥ 45 total repetitions: 59 treatment arms; 52%). In general, considerable overlap was identified between pooled mean effect size estimates of lower and higher volume exercise including primary meta-analyses of outcomes generating large effect sizes ($\beta_{\text{Lower:Higher}}$ =-0.05 [95%CrI: -0.42 to 0.37; p = 0.563]) and outcomes generating small effect sizes ($\beta_{\text{Lower:Higher}}$ =-0.17 [95%CrI: -0.44 to 0.10; p = 0.886; Table 4). Whilst the median point estimates from the primary meta-analyses favoured lower volume exercise, this ordering was not consistently maintained when analyses were separated by tendinopathy location (Supplementary file SF7c).

Combined analysis

As a final analysis, a meta-regression including the above intensity, frequency and volume variables were included to assess for differences in the pooled mean effect size whilst controlling for each other across all tendinopathy locations. A total of 70 studies (96 treatment arms) provided sufficient information for simultaneous coding of all three dose variables for outcomes generating large effect sizes, and 31 studies (42 treatment arms) provided sufficient information for outcomes generating small effect sizes. Results were consistent with analyses conducted individually on dosing variables, with evidence of increased pooled means with greater intensity for both outcomes generating large ($\beta_{\text{BodyMass:External}}$ =0.37 [95%CrI: -0.16 to 0.82; p = 0.916]) and small ($\beta_{\text{BodyMass:External}}$ =0.09 [95%CrI: -0.18 to 0.40; p = 0.722]) effect sizes. Similarly, evidence of increased pooled means was obtained for the lowest frequency therapies for both outcomes generating large ($\beta_{<Daily:Daily}$ = -0.81 [95%CrI: -1.4 to -0.20; p = 0.996]; $\beta_{<Daily:>Daily}$ = -0.68 [95%CrI:-1.3 to -0.13; p = 0.992]) and small ($\beta_{<Daily:Daily}$ = -0.56 [95%CrI:-0.88 to -0.244; p = 0.999]; $\beta_{<Daily:>Daily}$ = -0.36 [95%CrI:-0.71 to -0.01; p =0.977]) effect sizes. Finally, no evidence was obtained for a moderating effect of training volume for outcomes generating either large ($\beta_{\text{Lower:Higher}}$ =0.07 [95%CrI: -0.42 to 0.57; p = 0.617]) or small ($\beta_{\text{Lower:Higher}}$ =-0.08 [95%CrI: -0.38 to 0.22; p = 0.710]) effect sizes.

Table 2 Moderator analysis comparing average pooled effect size for body weight interventions versus interventions including additional external load. Results presented across all tendinopathies combined.

Moderator		Estimate of mean [95% CrI]	Probability	Study VPC [75% CrI]	Outcome VPC [75% CrI]	Measurement VPC [75% CrI]	Confidence in evidence
Large Effect Outcomes	Body mass 189 outcomes 33 treatment arms)	1.0 [0.68 to 1.4]	*p*(Body weight < Additional) = 0.976	0.78 [0.72 to 0.83]	0.15 [0.11 to 0.20]	0.03 [0.00 to 0.05]	Low
	Additional external (426 outcomes 78 treatment arms)	1.4 [1.2 to 1.7]					Moderate
Small Effect Outcomes	Body weight (98 outcomes 13 treatment arms)	0.36 [0.20 to 0.52]	*p*(Body weight < Additional) = 0.723	0.77 [0.70 to 0.83]	0.22 [0.16 to 0.42]	0.00 [0.00 to 0.01]	Low
	Additional external (266 outcomes 36 treatment arms)	0.44 [0.30 to 0.58]					Moderate

Large Effect Outcomes: Effect sizes obtained from outcomes measuring: 1) Disability; 2) Pain on loading/activity; 3) Pain without further specification; 4) Function; and 5) Pain over a specified time. Small Effect Outcomes: Effect sizes obtained from outcomes measuring: 1) Quality of Life; 2) Physical Functional Capacity. CrI= credible interval. VPC= variance partition coefficient.

Table 3 Moderator analysis comparing average pooled effect size for different training frequencies. Results presented across all tendinopathies combined.

Moderator		Estimate of mean [95% CrI]	Probability	Study VPC [75% CrI]	Outcome VPC [75% CrI]	Measurement VPC [75% CrI]	Risk of Bias
Large Effect Outcomes	Less than daily (188 outcomes 35 treatment arms)	1.8 [1.5 to 2.1]	*p*(Less than daily > Once per day) > 0.999	0.77 [0.71 to 0.82]	0.19 [0.15 to 0.25]	0.02 [0.00 to 0.06]	Low
	Once per day	1.1 [0.71 to 1.5]	*p*(Once per day < More than once				Moderate

	(160 outcomes 29 treatment arms)		per day) = 0.678				
	More than once per day (255 outcomes 46 treatment arms)	1.2 [0.90 to 1.5]	*p*(Less than daily > More than once per day) > 0.999				Moderate
Small Effect Outcomes	Less than daily (134 outcomes 15 treatment arms)	0.75 [0.27 to 0.71]	*p*(Less than daily > Once per day) >0.999	0.69 [0.60 to 0.78]	0.30 [0.22 to 0.39]	0.00 [0.00 to 0.01]	Moderate
	Once per day (137 outcomes 17 treatment arms)	0.34 [0.15 to 0.54]	*p*(Once per day < More than once per day) = 0.710				Moderate
	More than once per day (88 outcomes 16 treatment arms)	0.42 [0.24 to 0.61]	*p*(Less than daily > More than once per day) =0.992				Low

Large Effects: Effect sizes obtained from outcomes measuring: 1) Disability; 2) Pain on loading/activity; 3) Pain without further specification; 4) Function; and 5) Pain over a specified time. Small Effects: Effect sizes obtained from outcomes measuring: 1) Quality of Life; 2) Physical Functional Capacity. CrI= credible interval. VPC= variance partition coefficient.

Table 4 Moderator analysis comparing average pooled effect size for binary resistance volume categorisation. Results presented across all tendinopathies and individual tendinopathies.

Moderator		**Estimate of mean [95% CrI]**	**Probability**	**Study VPC [75% CrI]**	**Outcome VPC [75% CrI]**	**Measurement VPC [75% CrI]**	**Risk of Bias**
Large Effect Outcomes	Lower Volume (265 outcomes 49 treatment arms)	1.4 [1.1 to 1.7]	*p*(Higher volume < Lower volume) = 0.563	0.81 [0. 74 to 0.85]	0.17 [0.13 to 0.22]	0.02 [0.00 to 0.06]	Moderate
	Higher Volume (318 outcomes 57 treatment arms)	1.3 [1.1 to 1.6]					Moderate

Small Effect Outcomes	Lower Volume (169 outcomes 24 treatment arms)	0.56 [0.36 to 0.75]	*p*(Higher volume < Lower volume) = 0.886	0.77 [0.69 to 0.83]	0.23 [0.17 to 0.30]	0.00 [0.00 to 0.01]	Moderate
	Higher Volume (173 outcomes 21 treatment arms)	0.39 [0.19 to 0.58]					Moderate

Large Effects: Effect sizes obtained from outcomes measuring: 1) Disability; 2) Pain on loading/activity; 3) Pain without further specification; 4) Function; and 5) Pain over a specified time. Small Effects: Effect sizes obtained from outcomes measuring: 1) Quality of Life; 2) Physical Functional Capacity. CrI= credible interval. VPC= variance partition coefficient.

6.0 Discussion

This review provides the largest synthesis of training dose in resistance exercise therapy for tendinopathy management to date. The review included 91 studies across the five most common tendinopathy locations. The studies comprised diverse therapies with many comprising resistance exercise only, and others frequently combining resistance exercise with flexibility training. Despite the extensive variability in therapies, some general patterns were identified indicating that increased loading with greater time for recovery may produce superior results. Meta-regressions consistently identified greater effect size estimates for therapies employing higher intensity exercise through the addition of external loads compared to body mass only exercise. Similarly, meta-regressions consistently identified greater effect size estimates for therapies performed with a low frequency (less than once per day) compared with very high frequencies (once per day or more than once per day) that were also likely to comprise reduced loading to enable recovery. Less consistent results were obtained for moderator analyses investigating exercise volume.

One of the challenges in investigating resistance intensity in this review was the lack of clear reporting of actual intensities used in studies. Studies using Therabands for resistance did not report the relative resistance provided or in general comment on intensity progression. Although some studies identified progression in intensity through additional load using for example a dumbbell or loaded backpack, many did not state the actual loads recommended or used. Due to these limitations a cruder proxy of resistance intensity was investigated in this review based on the binary categorisation of lower intensity exercise involving just body mass, or higher intensity exercise involving additional external resistance. Evidence from the current review indicating superior results with greater resistance training intensities is consistent with findings from previous studies that higher intensities during resistance exercise are more effective and create better adaptive responses in the mechanical properties of tendons (43,44). Malliaras (43) compared different load intensities (as a percentage of concentric-eccentric or eccentric 1RM) on a leg extension machine (3 x week for 12 weeks) and a control condition with 38 individuals with patellar tendinopathy. The group that performed high load (80% of eccentric 1RM) eccentric exercise demonstrated the greatest improvements in strength and patellar tendon properties (43).

In the present review, consistent evidence was obtained indicating that performing resistance exercises less frequently throughout the week (less than once per day) was more effective compared to once per day or greater. Similarly, Tumilty and colleagues (45) compared different frequencies of Alfredson's heavy load eccentric exercise protocol in Achilles tendinopathy and found no added benefit from exercising twice daily compared to twice a week. To achieve musculotendinous unit hypertrophy with resistance exercise requires high levels of activation (46,47). Taking into consideration the microtrauma caused by resistance exercise in the tendon tissue this would be optimised with adequate rest periods between sessions (46,47). Allowing greater recovery times between sessions may play a role in the effectiveness of interventions.

In the present review, comparisons of exercise volume, commonly reported as the product of sets and repetitions did not produce consistent results. However, it is worth noting that meta-regressions investigating volume for RCRSP tendinopathies provided some evidence of increased effectiveness of higher volume exercise for both outcome domains producing large and small effect sizes. RCSP studies included in this review commonly prescribed lower intensities of resistance for the upper limb with a focus on range of motion and mobility (13-15). Maenhout (15) found that the addition of a heavy load resistance exercise performed twice a day, to traditional RCRSP training did not have any additional benefit to pain and function (SPADI score) in patients. A recent review by Malliaras (48) found low quality evidence suggesting that higher volume and intensity exercise (or higher volume alone) may have superior functional outcomes compared with lower doses, but not for pain outcomes, in RCRSP tendinopathies. However, they were limited to just three studies due to their inclusion criteria and lack of clear reporting in the literature (48). The shoulder joint tendons facilitate repetitive movements of daily tasks with less overall load than larger weight bearing tendons like the Achilles and may require programmes that imitate that repetitive nature through higher volume of exercise.

One of the limitations of this study and a challenge for future evidence syntheses is the lack of clear reporting of exercise dose in the tendinopathy management literature. In this review we found that in general exercise volume and frequency were better reported, however, reporting of intensity was frequently poor. A recent systematic review investigating the effects of exercise dose in RCRSP tendinopathy only included three studies in the meta-analysis due to poor reporting (48) and was limited in the analyses that could be performed. Similarly, it was found in the present review that although load progression was frequently stated, studies rarely reported the actual loads or intensity used. Understandably progressions are matched to individuals, however, more detailed reporting of loads prescribed and ultimately used across participants would be useful for future evidence syntheses and better inform clinicians. Relative intensity measures such as precent of maximum repetition (%RM) are likely to provide the most useful information for future evidence syntheses and the most precise comparisons.

An additional substantive limitation of the present review includes the use of non-controlled effect sizes. This approach was adopted due to the ability to greatly increase the amount of data available and address limitations of previous reviews of based largely on small sample sizes and subsequent decisions not to quantitatively synthesise results. The major limitation of this approach is the potential for unbalanced treatment moderators including a range of intervention and population characteristics to associate with different levels of the dose variables defined, thus biasing results. Given the likely interaction between intensity, volume and frequency, we attempted to control for these interactions by including a more complete meta-regression with all three variables included. Whilst the results of the analysis supported those obtained with the individual meta-regressions, there are likely to be many other effect moderators including intervention duration, adherence and baseline characteristics of patients (49,50) that may have been imbalanced and could not be controlled. In a previous analysis conducted with similar data we showed that effect size values are greatly influenced by outcome domains and could be summarised by a binary classification (31). As a result, we conducted analyses in the present review based on outcome domains that tended to generate large and small effects. However, it is possible that this binary classification represents too much of a simplification and imbalances in outcomes may also have biased results. Large increases in data were obtained by pooling results across the different tendinopathy locations. This approach was adopted based on our previous analysis indicating that the distribution of effect sizes following exercise therapy is likely to be similar (31). However, where sufficient data were available to conduct meta-regressions for individual tendinopathy locations, results tended to be consistent. Finally, another limitation of the review included the confidence in cumulative evidence which was most frequently identified as low and in a number of cases very low. This was predominantly due to extensive heterogeneity in studies resulting in issues of inconsistency and imprecision in effect size estimates.

Clinical Implications

The results of this large systematic review and meta-analysis suggest that where resistance exercise is being prescribed for tendinopathy managements, clinicians should consider whether a sufficient stimulus with regards to exercise intensity is being adopted and there is appropriate time for recovery. For certain patients this may require a substantive period of progression. However, when appropriate, clinicians should consider higher intensities through the application of external loads rather than just body mass, and given increases loading lower frequencies of including less than daily may be required to allow for adequate recovery. Further refinement of the interrelations between exercise dose parameters and patient characteristics are required, including better understanding of the influence of exercise volume.

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Conflicts of interest

The authors declare no conflict of interest.

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SF1: Definitions used to define exercise treatments and treatment classes.

Treatment Class	Definition	Treatment	Definition
Resistance	Exercise designed primarily to increase strength of muscles by causing them to produce substantive force against an applied resistance which can take several forms including the mass of the body or its segments, isoinertial resistance, elastic resistance, or strength training equipment such as isokinetic devices.	Concentric Only	Includes movements where force produced overcomes the resistance such that muscle shortening occurs.
		Eccentric Only	Includes movements where force produced is less than the resistance such that controlled muscle lengthening occurs.
		Concentric and eccentric	Includes movements where force produced exceeds the resistance in one phase and is less than the resistance in another such that controlled muscle lengthening and shortening occurs.
		Isokinetic	Uses specialised exercise equipment such that the resistance is adjusted in real-time to ensure joint angular velocity remains constant.
		Isometric	Includes muscular actions against a resistance such that joint angle remains constant.

SF2: Outcome domains and example outcomes included in review.

Domain	ICON Definition	Example Tools
Disability	Composite scores of a mix of patient-rated pain & disability due to the pain, usually relating to tendon-specific activities/tasks	VISA scales; DASH; quick DASH; SPADI; Patient-rated tennis-elbow evaluation questionnaire; Constant Murley Score; WORC (Western Ontario Rotator Cuff Index); AOFAS (American Orthopaedic Foot & Ankle Society); Roles and Maudsley score; ASES (American Shoulder & Elbow Surgeons Index); Hip & Groin Outcome Score; Foot & Ankle outcome score (FAOS)/Questionnaire (FAOQ); Oxford hip score (OHS); Hip disability & outcome OA score (HOOS); Tegner activity score; Lysholm knee scale; Pain free function questionnaire; Ankle activity score; Subjective elbow Value (SEV); Placzek score; Shoulder disability questionnaire; Foot function index (FFI); International Knee Documentation Committee form (IKDC); Penn Shoulder score (university of Pennsylvania shoulder score) (PSS); Brief pain inventory (BPI); UCLA Shoulder Rating Scale; FILLA - functional index of leg and lower limb; Neer Shoulder Score; Nirschl phase rating scale; Manchester–Oxford Foot Questionnaire (MOXFQ); American Shoulder and Elbow Surgeon's (MASES) questionnaire; Mayo Elbow Performance Score (MEPS); Shoulder rating questionnaire (SRQ);
Function	Participant/patient rated level of function (and not referring to the intensity of their pain; eg, Patient Specific Function Scale on a VAS or NRS).	Patient-specific functional scale
Pain on loading/activity	Patient reported intensity of pain performing a task that loads the tendon	VAS; NRS; Pain experience scale
Pain over a specified time	Patient-reported pain intensity over period of time e.g. morning/night/24-hours/1-week	VAS; NRS Painful days in 3 months
Pain without further specification	Patient asked about pain levels without reference to activity or timeframe	VAS; NRS; Borg CR10 Scale; Pain status
Physical function capacity	Quantitative measures of physical tasks (e.g. hops, times walk, single leg squat) includes muscle strength	Counter movement jump; one-leg triple hop; single-leg decline squat; muscle strength measured by dynamometry (hand-held, isokinetic); manual muscle testing.
Quality of Life	General wellbeing	EQ5D; EQ3D; SF-36 or SF-12; Assessment of Quality of Life (AQoL); Nottingham Health Profile; Gothenburg QoL Instrument
Range of Motion (shoulder only)	Active or passive range of motion in specified plane, measured in degrees.	Hand-held goniometer; inclinometer

VISA= Victorian Institute of Sport Assessment; DASH =Disabilities of the Arm, Shoulder and Hand; OA= osteoarthritis; VAS= visual analogue scale; NRS= Numerical Rating Scale.

SF3: Example search strategy

MEDLINE (EBSCoHost)
Search conducted on 27 April, 2020

Search	Query	Records retrieved
#1	MH exercise OR AB exercis* OR MH "isometric contraction" OR MH rehabilitation OR TX eccentric OR TX concentric OR TX "heavy slow resistance" OR TX isokinetic	362,722
#2	MH tendinopathy OR MH "shoulder injuries" OR MH tendons OR MH "tendon injuries" OR TX tendin* OR TX tendon* OR MH bursitis OR AB bursitis OR MH "posterior tibial tendon dysfunction" OR MH "shoulder impingement syndrome" OR AB "greater trochanteric pain syndrome"	96,490
#3	#1 AND #2	4,363
Limited to 1998 to present		

SF4: Extraction codebook

Column		Heading	Description
Study Details	A	Initials Reviewer	Identification of individual extracting information
	B	Covidence Identifier	Reference number for Covidence
	C	Author	First author surname *et al.,*
	D	Year	Year of publication
	E	Title	Study title
	F	Country	Country where study was conducted
	G	Journal	Journal name
	H	Aims/Purpose	Study aims/purpose
	I	Tendinopathy type	1=Achilles; 2= Lateral elbow (tennis); 3 = Patellar; 4 = Rotator cuff related shoulder pain (RCRSP)
	J	Study Design	RCT = 1; Quasi-experimental = 2
	K	Age Mean	Mean age of study sample as a whole
	L	Age SD	Standard deviation age of study sample as a whole
	M	Baseline Total N	Total sample across all interventions measured at baseline
	N	Training Status Description	Brief description of training status of study sample as a whole
	O	Training Status Code	1 = Performance; 2 = Sporting; 3 = Other
	P	Sex	Percentage female of study sample as a whole
	Q	BMI Mean	Mean BMI of study sample as a whole
	R	BMI SD	Standard deviation of BMI of study sample as a whole
	S	Symptom Severity Mean	Mean severity measure at baseline of study sample as a whole
	T	Symptom Severity SD	Standard deviation of severity measure at baseline of study sample as a whole
	U	Symptom Duration Mean (Months)	Mean symptom duration reported in months
	V	Symptom Duration SD (Months)	Standard deviation symptom duration reported in months
	W	Population Comments	Any additional information relevant to the participants investigated including diagnostic criteria
Outcomes	X	Outcome Category	1 = Disability; 2 = Pain on loading/activity; 3 = Pain over a specified time; 4 = Pain without further specification; 5 = Physical function capacity; 6 = Participant/patient rating overall condition; 7) Participation; 8) Quality of life; 9) Range of motion
	Y	Outcome Tool	Description of outcome tool
	Z	Reflection	1 = Increase in outcome indicates positive treatment; -1 = Decrease in outcome indicates positive treatment
	AA	Measurement Time (Weeks)	Time of measurement in weeks
Intervention	AB	Dominant Treatment Class	**Only one dominant theme to be selected** 1 = Resistance; 2 = Plyometric; 3 = Vibration; 4 = Flexibility; 5 = Movement pattern retraining
	AC	Total Treatment class	**Multiple themes to be selected as required** 1 = Resistance; 2 = Plyometric; 3 = Vibration; 4 = Flexibility; 5 = Movement pattern retraining

	AD	Dose Comparison	1 = Lower dose intervention; 2 = Higher dose intervention
	AE	Intervention N	Intervention sample size at specified time
	AF	Intervention Total Duration	Total duration of exercise intervention in weeks
	AG	Intervention Adherence %	Reporting of adherence to exercise (reported as a percentage) if applicable
	AH	Intervention Location	Location exercise was performed 1 = Home; 2 = Clinic; 3 = Fitness facility; 4 = NR; 5 = NA
	AI	Intervention Volume	Numerical value describing volume
	AJ	Intervention Volume Category	1 = Duration of session (mins); 2 = sets * repetitions; 3 = number of repetitions; 4 = number of sets
	AK	Intervention Volume Comments	Any additional information relevant.
	AL	Intervention Intensity	Numerical value describing intensity
	AM	Intervention Intensity Category	1 = Absolute; 2 = Relative; 3=Bodyweight; 4=bodyweight+
	AN	Intervention Frequency	Number of sessions per week. Where there is progression, average value is to be entered.
	AO	Intervention Frequency Comments	Any additional information relevant.
	AP	Intervention Progression	**Multiple themes to be selected as required** 1 = No progression; 2 = NR; 3 = Progression volume; 4 = Progression intensity; 5 = Progression frequency; 6 = Progression specificity; 7 = Progression capacity; 8 = Other
	AQ	Intervention Progression Comments	Any additional information relevant.
Data	AR	Intervention Baseline Mean	Baseline mean for exercise therapy
	AS	Intervention Baseline SD	Baseline standard deviation for exercise therapy
	AT	Intervention Measurement Mean	Mean of outcome for exercise therapy at stated time point
	AU	Intervention Measurement SD	Standard deviation of outcome for exercise therapy at stated time point
	AV	Measurement Comments	State if a different value has been entered for means (e.g. median), a different value for standard deviations (e.g. standard error, IQR, percentiles, distance from mean to upper bound). Provide the relevant statistic (width of CI's, width of percentiles). Also state if data has extracted by digitization

* Outcome Specific. RCT=randomized controlled trial; SD=standard deviation; BMI= body mass index; NR= not reported; NA= not applicable; IQR=Inter Quartile Range; CI= confidence intervals.

SF5 Included studies

Supplementary table 5A. Table of included studies (n=91)

Study (first author, year, country)	Design	Tendinopathy Location	Participants (number (n); sex (%female); mean (sd) age; mean (sd) symptom duration in months)	Exercise Treatment arms	Dominant resistance treatment	Findings
Alfredson 1998 Sweden[1]	Quasi-experimental	Achillies	N= 30 % female 20.0 Age 44.0 (7.0) Symptoms 25.9 (3-100)** Training status Recreational	1	Eccentric only	Our treatment model with heavy-load eccentric calf muscle training has a very good short-term effect on athletes in their early forties
Alfredson 1999 Sweden[2]	Quasi-experimental	Achilles	N= 24 % female 14.3 Age 42.6 (9.0) Symptoms 23.7 (3-100)** Training status Recreational	1	Eccentric only	Heavy-loaded, eccentric calf-muscle training seems to be a good treatment mode for chronic Achilles tendinosis.
Arias-Buría 2017 Spain[3]	RCT	Rotator cuff - subacromial impingement	N= 50 % female 26.0 Age 48.5 (5.5) Symptoms 71.9 (21.6) Training status Other	1	Concentric and eccentric	This study found that the inclusion of 2 sessions of TrP-DN into an exercise program was effective for improving shoulder pain-related disability at short-, medium-, and long-term; however, no greater improvement in shoulder pain was observed.
Arias-Buría 2015	RCT	Rotator cuff - subacromial	N= 36 % female 75.0	1	Concentric and eccentric	Ultrasound-guided percutaneous electrolysis combined with eccentric

Spain[4]		impingement	Age 57.5 (6.4) Symptoms 10.9 (2.6) Training status Other			exercises resulted in better short-term outcomes compared to eccentric exercises alone.
Bahr 2006 Norway[5]	RCT	Patellar	N= 40 % female 12.5 Age 30.5 (7.9) Symptoms 34 (28.7) Training status Other	1	Eccentric only	No added benefit was observed for surgical treatment to eccentric strength training. Eccentric training should be offered for 12 weeks before tenotomy is considered for the treatment of patellar tendinopathy.
Balius 2016 Spain[6]	RCT	Achilles	N=37 % female 20.4 Age 41.4 (11.7) Symptoms NR Training status Other	6	3*Eccentric only	Findings confirmed the therapeutic potential of eccentric exercise at reactive and degenerative stages of tendinopathy. MCVC supplementation decreased pain more than eccentric exercise alone (reactive tendinopathy) Personalized stretching regime supplemented with MCVC may be appropriate for some patients
Beyer 2015 Denmark[7]	RCT	Achilles	N= 58 % female 31.9 Age 48.0 (2.0) Symptoms 18.1 (4.3) Training status Other	2	Eccentric only; Concentric and eccentric	Both traditional eccentric exercise and HSR yield positive, equally good and lasting clinical results in patients with Achilles tendinopathy. HSR is associated with greater patient satisfaction after 12 weeks but not after 52 weeks.
Blume 2015 United States[8]	RCT	Rotator cuff - subacromial impingement	N= 34 % female 58.0 Age 49.4 (15.6) Symptoms 22.7 (24.3) Training status Other	2	Concentric only; Eccentric only	Both eccentric and concentric PRE programs resulted in improved function, AROM, and strength in patients with SAIS. However, no difference was found between the two exercise modes, suggesting that therapists may use exercises that utilize either exercise mode in their treatment of SAIS.

Boudreau 2019 Canada[9]	RCT	Rotator cuff - subacromial impingement	N= 42 % female 52.4 Age 42.9 (12.0) Symptoms 43.0 (46.6) Training status Other	2	2*Concentric and eccentric	No additional benefit was found to adding coactivation to regular rotator cuff strengthening exercises at 6-weeks.
Breda 2020 Netherlands[10]	RCT	Patellar	N= 76 % female 23.7 Age 24 (3.9) Symptoms 98.5 (NR) Training status Performance	2	Isometric; Eccentric only	In patients with patellar tendinopathy, progressive tendon-loading exercises resulted in a significantly better clinical outcome after 24 weeks than eccentric exercise therapy. Progressive tendon-loading exercises are superior to eccentric exercise therapy and are therefore recommended as initial conservative treatment for patellar tendinopathy.
Chaconas 2017 United States[11]	RCT	Rotator cuff - subacromial impingement	N=46 % female 41.7 Age 45.9 (17.4) Symptoms 49.1 (80) Training status Other	2	Eccentric only	An eccentric program targeting the external rotators was superior to a general exercise program for strength, pain, and function after six months. The findings suggest eccentric training may be efficacious to improve self-report function and strength for those with SAPS.
Cheng 2007 Hong Kong, China (SAR)[12]	RCT	Rotator cuff - subacromial impingement	N=94 % female Age 32.4 (10.2) Symptoms 23.4 Training status Other	2	2*Concentric and eccentric	An eccentric program targeting the external rotators was superior to a general exercise program for strength, pain, and function after six months. The findings suggest eccentric training may be efficacious to improve self-report function and strength for those with subacromial pain syndrome.
Cho 2017 Korea (Republic	Quasi-experimental	Patellar	N= 30 % female 46.7 Age 33.1 (29.1)	1	Eccentric only	A rehabilitation exercise programme was more effective at improving pain, strength and function in

of)[13]			Symptoms 15.1 (16.1) Training status Other			patellar tendinopathy that injection therapy alone.
de Jonge 2008 Netherlands[14]	RCT	Achilles	N= 70 % female NR Age 44.6 (26-59) ** Symptoms 30.7 (2-204) ** Training status Other	1	Eccentric only	Eccentric exercises with or without a night splint improved functional outcome at one year follow-up. At follow-up there was no significant difference in clinical outcome when a night splint was used in addition to an eccentric exercise.
de Vos 2007 Netherlands[15]	RCT	Achilles	N= 63 % female 41.3 Age 44.6 (8) Symptoms 30.6 (50.6) Training status Recreational	1	Eccentric only	A night splint has no added benefit to eccentric exercises in the treatment of chronic midportion Achilles tendinopathy. There was no significant difference between the two groups in VISA-A score and patient satisfaction.
Dejaco 2017 Netherlands[16]	RCT	Rotator cuff - subacromial impingement	N=36 % female 47.3 Age 49.5 (11.3) Symptoms 19.7 (20.1) Training status Other	2	Eccentric only; Concentric and eccentric	12-week-isolated eccentric training programme of the RC is beneficial for shoulder function and pain after 26 weeks in patients with RC tendinopathy. However, it is no more beneficial than a conventional exercise programme for the RC and scapular muscles.
Dimitrios 2012 Greece[17]	Quasi-experimental	Patellar	N= 60 % female 36.7 Age 47.6 (5.9) Symptoms 4.5 (NR) Training status Other	2	Eccentric only	Eccentric training and static stretching exercises is superior to eccentric training alone to reduce pain and improve function in patients with patellar tendinopathy at the end of the treatment and at follow-up.
Dupuis 2018 Canada[18]	RCT	Rotator cuff - subacromial	N=43 % female 55.8 Age 33.3 (11.7)	2	Isometric	Both groups showed statistically significant improvements on symptoms and function at 2 weeks

		impingement	Symptoms 0.9 (0.3) Training status Other			and 6 weeks but there was no difference between the short-term effect of cryotherapy and a gradual reloading exercise programme.
Ganderton 2018 Australia[19]	RCT	Gluteal	N=90 %female 100 Age 61.83 (7.81) Symptoms NR Training status Other	2	Concentric and eccentric	Lack of treatment effect was found with the addition of an exercise program to a comprehensive education on GTPS management. The improved outcomes of the responders in the GLoBE group indicate that there may be a subgroup of patients with a GTPS diagnosis that benefit from a GLoBE intervention program.
Gatz 2020 Germany[20]	RCT	Achilles	N= 42 % female 35.7 Age 50.0 (12.0) Symptoms 27.5 (23.8) Training status Other	2	Eccentric only; Isometric	No additional clinical benefits of adding ISOs to a basic EE program could be found in this preliminary randomized controlled trial study over a period of 3 months. SWE was able to differentiate between insertional and midportion tendon tissue and localize reported symptoms to sublocations but this did not correlate with better clinical scores (VISA-A) over a 3-month follow-up period.
Giray 2019 Turkey[21]	RCT	Lateral elbow/tennis elbow	N= 30 % female 86.7 Age 44.46 (9.92) Symptoms 1.69 (NR) Training status Other	1	Eccentric only	Kinesiotaping in addition to exercises is more effective than sham taping and exercises alone in improving pain in daily activities and arm disability due to lateral epicondylitis.
Hallgren 2014 Sweden[22]	RCT	Rotator cuff - subacromial impingement	N= 50 % female 37.0 Age 52 (30-65)** Symptoms 18 (6-186)*	2	Eccentric only	Specific exercises produced positive short-term improvements at 1-year follow-up and reduces the need for surgery. Full-thickness tear and a low CMS score appear to be

			Training status Other			predictors of poor outcome.
Hallgren 2017 Sweden[23]	RCT	Rotator cuff - subacromial impingement	N= 108 % female 34.1 Age 58 (NR) Symptoms NR Training status Other	2	Concentric and eccentric	More patients in the specific exercise group managed to avoid surgery compared to the unspecific exercise group at 5-year follow-up supporting it's prescription as an initial treatment for patients with subacromial pain.
Heron 2017 United Kingdom[24]	RCT	Rotator cuff - subacromial impingement	N= 120 % female 41.0 Age 49.9 (NR) Symptoms NR Training status Other	3	2*Concentric and eccentric	Open chain, closed chain, and range of movement exercises all seem to be effective in bringing about short-term changes in pain and disability in patients with rotator cuff tendinopathy.
Hotta 2020 Brazil[25]	RCT	Rotator cuff - subacromial impingement	N=60 % female 70 Age 49 (9) Symptoms 28.5 (24) Training status Other	2	Concentric and eccentric	The inclusion of the isolated scapular stabilization exercises, emphasizing retraction and depression of the scapula, to a progressive general periscapular strengthening protocol did not add benefits to self-reported shoulder pain and disability, muscle strength, and ROM in patients with subacromial pain syndrome.
Johansson 2005 Sweden[26]	RCT	Rotator cuff - subacromial impingement	N=85 % female 69.4 Age 49 (7.5) Symptoms NR Training status Other	1	Isometric	Acupuncture was more effective than ultrasound when applied in addition to home exercises.
Jonsson 2005 Sweden[27]	RCT	Patellar	N= 15 % female 13.3 Age 24.9 (8.2) Symptoms 17.5 (13.2) Training status	2	Eccentric only; Concentric only	Eccentric, but not concentric, quadriceps training on a decline board, seems to reduce pain in jumper's knee.

			Performance			
Ketola 2009 Finland[28]	RCT	Rotator cuff - subacromial impingement	N=134 % female 62.9 Age 47.1(23.3-60.0)** Symptoms 2.6 (NR) Training status Other	1	Concentric and eccentric	Arthroscopic acromioplasty provides no clinically important effects over a structured and supervised exercise programme alone in terms of subjective outcome or cost-effectiveness when measured at 24 months.
Knobloch 2008 Italy[29]	RCT	Achilles	N= 92 % female 35.0 Age 47.5 (11.0) Symptoms NR Training status Recreational	1	Eccentric only	Patients with tendinopathy of the main body of the AT experienced improved clinical outcome with both management options. Although tendon microcirculation was optimized in the combined group of eccentric training and AirHeel Brace, these micro-vascular advantages do not translate into superior clinical performance when compared with eccentric training alone.
Knobloch 2007 Germany[30]	RCT	Achilles	N= 20 % female 45.0 Age 32.5 (11.0) Symptoms NR Training status	1	Eccentric only	An eccentric-training program performed daily over 12 weeks reduced the increased paratendinous capillary blood flow in Achilles tendinopathy by as much as 45% and decreased pain level based on a visual analog scale. Local paratendon oxygenation was preserved while paratendinous postcapillary venous filling pressures were reduced after 12 weeks of eccentric training, which appears to be beneficial from the perspective of microcirculation.
Knobloch 2007 Germany[31]	RCT	Achilles	N= 118 % female 40 Age 48.5 (12)	1	Eccentric only	Achilles tendon oxygen saturation is increased, and capillary venous clearance facilitated using an

			Symptoms NR Training status Other			Achilles wrap in addition to daily 12-week eccentric training
Kongsgaard 2009 Denmark[32]	RCT	Patellar	N= 37 % female 0 Age 32.4 (8.8) Symptoms 18.7 (12.3) Training status Recreational	2	Eccentric only; Concentric and eccentric	Corticosteroid injection has good short-term but poor long-term clinical effects, in patellar tendinopathy. Heavy-slow resistance exercise has good short- and long-term clinical effects accompanied by pathology improvement and increased collagen turnover.
Kromer 2014 Germany[33]	RCT	Rotator cuff - subacromial impingement	N= 90 % female 51.1 Age 51.8 (11.2) Symptoms 24.1 (35.1) Training status Other	1	Concentric and eccentric	The use of MT including Physiotherapy provides no additional benefits and is more expensive in comparison to exercise only interventions.
Kromer 2013 Germany[34]	RCT	Rotator cuff - subacromial impingement	N= 90 % female 51.1 Age 51.8 (11.2) Symptoms 7.8 (9.8) Training status Other	1	Concentric and eccentric	Individually adapted exercises were effective in the treatment of patients with shoulder impingement syndrome. Individualized manual Physiotherapy contributed only a minor amount to the improvement in pain intensity.
Littlewood 2016 United Kingdom[35]	RCT	Rotator cuff - subacromial impingement	N= 60 % female 50.3 Age 54.7 (NR) Symptoms 14.6 (NR) Training status Other	1	Concentric and eccentric	Self-management programme based on a single exercise were comparable to usual Physiotherapy in the short-, mid- and long-term.
Luginbuhl 2008 Switzerland[36]	RCT	Lateral elbow/tennis elbow	N= 30 % female 72.7 Age 47 (9) Symptoms 10	1	Isometric	No beneficial effect of neither the forearm support band nor the strengthening exercises could be found.

			(11) Training status Other			
Maenhout 2013 Belgium[37]	RCT	Rotator cuff - subacromial impingement	N= 61 % female 59.0 Age 39.8 (13.0) Symptoms NR Training status Other	2	Concentric and eccentric; Eccentric only	Adding heavy load eccentric training resulted in a higher gain in isometric strength at 90 degree of scapular abduction but was not superior for decreasing pain and improving shoulder function. The addition of a limited amount of Physiotherapy sessions combined with a daily home exercise programme is highly effective in patients with impingement.
Mafi 2001 Sweden[38]	RCT	Achilles	N= 44 % female 45.5 Age 48.3 (8.8) Symptoms 20.5 (3-120)** Training status Other	2	Eccentric only; Concentric only	Eccentric calf muscle training showed superior results to concentric training in the treatment of chronic Achilles tendinosis based on patient satisfaction and return to activity level.
Manias 2006 United Kingdom[39]	RCT	Lateral elbow/tennis elbow	N= 40 % female 67.5 Age 42.86 (6.23) Symptoms NR Training status Other	2	2*Eccentric only	An exercise programme consisting of eccentric and static stretching exercises had reduced the pain in patients with lateral epicondyle tendinopathy at the end of the treatment and at the follow up whether or not ice was included.
Martinez-Silvestrini 2005 United States[40]	Quasi-experimental	Lateral elbow/tennis elbow	N= 81 % female 46.8 Age 45.5 (7.7) Symptoms NR Training status Other	3	Concentric only; Eccentric only	Eccentric strengthening for the wrist extensors in subjects with lateral epicondylitis demonstrated improvement at six weeks but was not statistically different from that achieved with a conservative program with stretching or a concentric strengthening program.
Marzetti 2014	RCT	Rotator cuff - subacromial	N= 48 % female 61.4	2	Concentric and eccentric	Neurocognitive rehabilitation is effective in reducing pain and

Italy[41]		impingement	Age 62.1 (12.5) Symptoms NR Training status Other			improving function in patients with shoulder impingement syndrome, with benefits maintained for at least 24 weeks.
McCormack 2016 United States[42]	RCT	Achilles	N= 15 % female 68.8 Age 53.6 (38-69)** Symptoms 9.9 (NR) Training status Other	1	Eccentric only	Soft tissue treatment (Astym) plus eccentric exercise was more effective than eccentric exercise alone at improving function during both short- (26 weeks) and long-term (52 weeks) follow-up periods.
Mulligan 2016 United States[43]	RCT	Rotator cuff - subacromial impingement	N=50 % female 65 Age 50.1 (10.7) Symptoms 7.9 (7.4) Training status Other	1	Concentric and eccentric	Patients with SAIS demonstrate improvement in pain and function with a standardized program of physical therapy regardless of group exercise sequencing.
Nørregaard 2007 Denmark[44]	RCT	Achilles	N= 35 % female 49.0 Age 42.0 (2.0)*** Symptoms 28.4 (8.8)*** Training status Other	2	Eccentric only	Symptoms gradually improved during the 1-year follow-up period and were significantly better assessed by pain and symptoms after 3 weeks and all later visits. However, no significant differences could be observed between the two groups.
Nowotny 2018 Germany[45]	RCT	Lateral elbow/tennis elbow	N= 31 % female 57 Age 46 (NR) Symptoms NR Training status Other	1	Eccentric only	The use of an elbow orthosis appears to reduce pain and improve other subjective outcome measures. However, the long-term results do not appear to be any greater than those received through Physiotherapy alone.
Østerås 2010 Norway[46]	RCT	Rotator cuff - subacromial	N=61 % female 20.5 Age 43.9 (13)	2	2*Concentric and eccentric	In long-term subacromial pain syndrome, high dosage medical exercise therapy is superior to a

		impingement	Symptoms 40.2 (56.3) Training status Other			conventional low dosage exercise programme
Park 2010 Korea (Republic of)[47]	RCT	Lateral elbow/tennis elbow	N=31 % female 61.3 Age 50.2 (34-63)** Symptoms 6.3 (2-17)** Training status NR	1	Isometric	Isometric strengthening exercises done early in the course of LE (within 4 weeks) provides a clinically significant improvement.
Pearson 2012 New Zealand[48]	RCT	Patellar	N= 40 % female 62.5 Age 50.0 (8.2) Symptoms 11.0 (10.0) Training status Other	1	Eccentric only	There is some evidence for small short-term symptomatic improvements with the addition of autologous blood injection to standard treatment for Achilles tendinopathy.
Pearson 2018 Australia[49]	RCT	Achilles	N= 16 % female 0 Age 28 (4.25) Symptoms 34.17 (1.95) Training status Performance	2	2* Isometric	Pain was significantly reduced after isometric loading on both SLDS and hop tests. Pain and quadriceps function improved over the 4 weeks. Short-duration isometric contractions are found to be as effective as longer duration contractions for relieving patellar tendon pain when total time under tension is equalized.
Pekyavas 2016 Turkey[50]	RCT	Rotator cuff - subacromial impingement	N=70 % female NR Age 47.1 (13.8) Symptoms NR Training status Other	1	Concentric and eccentric	HILT and MT were found to be more effective in reducing pain and disability and improving ROM in patient with SAIS.

Petersen 2007 Germany[51]	RCT	Achilles	N= 86 % female 40.0 Age 42.5 (11.1) Symptoms 7.4 (2.3) Training status Recreational	1	Eccentric only	The AirHeel brace is as effective as eccentric training in the treatment of chronic Achilles tendinopathy. There is no added benefit to combining both treatments.
Peterson 2011 Sweden[52]	RCT	Lateral elbow/tennis elbow	N= 81 % female 42 Age 48.25 (8.35) Symptoms 23.3 (35.9) Training status Other	2	Concentric and eccentric	Exercise appears to be superior to the control group in reducing pain in chronic lateral epicondylosis.
Peterson 2014 Sweden[53]	RCT	Lateral elbow/tennis elbow	N= 120 % female 47.5 Age 47.9 (8.1) Symptoms NR Training status Other	1	Eccentric only; Concentric only	Eccentric graded exercise reduced pain and increased muscle strength in chronic tennis elbow more effectively than concentric graded exercise at follow-up. However, there were no significant differences in function or quality of life measures between the two groups.
Praet 2019 Australia[54]	RCT	Achilles	N= 20 % female 35.0 Age 43.7 (7.9) Symptoms 54 (90) Training status Recreational	1	Eccentric only	Oral supplementation of specific collagen peptides may accelerate the clinical benefits of a well-structured calf-strengthening and return-to-running programme in patients with chronic Achilles tendinopathy.
Rabusin 2020 Australia[55]	RCT	Achilles	N= 100 % female 52.0 Age 45.85 (9.4) Symptoms 20.25 (NR) Training status Other	1	Eccentric only	In adults with mid-portion Achilles tendinopathy, heel lifts were more effective than calf muscle eccentric exercise in reducing pain and improving function at 12 weeks.

Rio 2017 Australia[56]	RCT	Patellar	N= 20 % female 10.0 Age 22.5 (4.7) Symptoms NR Training status Performance	2	Concentric and eccentric; Isometric	Both isometric and isotonic contraction protocols appear efficacious for in-season athletes to reduce pain, however, isometric contractions demonstrated significantly greater immediate analgesia throughout the 4-week trial.
Romero-Morales 2020 Spain[57]	RCT	Achilles	N= 61 % female 26 Age 41.6 (8.7) Symptoms 4.25 (3.5) Training status Other	2	Eccentric only	Authors encourage the use of vibration with respect to cryotherapy added to eccentric exercise programs in order to enhance multifidus cross-sectional area in addition to lower limb functionality in individuals who suffer from chronic non-insertional AT.
Rompe 2007 Germany[58]	RCT	Achilles	N= 75 % female 61.3 Age 48.5 (10.6) Symptoms 10.8 (8.5) Training status Other	1	Eccentric only	At 4-month follow-up, eccentric loading and low-energy shock-wave therapy showed comparable results. The wait-and-see strategy was ineffective for the management of chronic recalcitrant Achilles tendinopathy.
Rompe 2009 Germany[59]	RCT	Achilles	N= 68 % female 55.9 Age 49.7 (9.9) Symptoms 14.5 (6.0) Training status Other	1	Concentric and eccentric	The likelihood of recovery after 4 months was higher after a combined approach of both eccentric loading and shock-wave therapy compared to eccentric loading alone.
Rompe 2009 Germany[60]	RCT	Gluteal (including GTPS)	N= 68 % female 55.9 Age 49.7 (9.9) Symptoms 14.5 (6) Training status Other	1	Eccentric only	Both corticosteroid injection and home training were significantly less successful than was shock wave therapy at 4-month follow-up. Corticosteroid injection was significantly less successful than was home training or shock wave

						therapy at 15-month follow-up.
Rompe 2008 Germany[61]	RCT	Achilles	N= 50 % female 60.0 Age 39.8 (11) Symptoms 25.55 (9.45) Training status Other	1	Eccentric only	Eccentric loading as applied in the present study showed inferior results to low-energy shock wave therapy as applied in patients with chronic recalcitrant tendinopathy of the insertion of the Achilles tendon at four months follow-up.
Roos 2004 Sweden[62]	RCT	Achilles	N= 44 % female 52.3 Age 45 (26-60)** Symptoms 5.5 (1-180)* Training status Recreational	1	Eccentric only	Eccentric exercises reduce pain and improve function in patients with Achilles tendinopathy.
Şenbursa 2011 Turkey[63]	RCT	Rotator cuff - subacromial impingement	N= 47 % female NR Age 49.0 (9.3) Symptoms NR Training status Other	2	2*Concentric and eccentric	Supervised exercise, supervised and MT, and home-based exercise are all effective and promising treatments for patients with subacromial impingement syndrome. The addition of an initial MT may improve outcomes with exercise.
Sevier 2015 United States[64]	RCT	Lateral elbow/tennis elbow	N= 90 % female 57.9 Age 46.95 (6.55) Symptoms NR Training status Other	1	Eccentric only	Astym therapy is an effective treatment option for patients with LE tendinopathy, as an initial treatment, and after an eccentric exercise program has failed.
Silbernagel 2007 Sweden[65]	RCT	Achilles	N= 38 % female 47.4 Age 46.0 (8.0) Symptoms 36.2 (66.5) Training status Other	2	2*Concentric and eccentric	Our treatment protocol which gradually increases the load on the Achilles tendon and calf muscle, demonstrated significant improvements. Continuing tendon loading activity such as running and jumping with the use of a pain-monitoring model did not have any

						adverse effect.
Silbernagel 2001 Sweden[66]	RCT	Achilles	N= 47 % female 22.5 Age 44.0 (12.5) Symptoms 30.5 (40.7) Training status Recreational	2	2*Concentric and eccentric	The eccentric overload protocol used in the present study can be recommended for patients with chronic pain from the Achilles tendon. More patients achieved full recovery, improved pain and ROM in the Exp group compared to the control group.
Şimşek, 2013 Turkey[67]	RCT	Rotator cuff - subacromial impingement	N= 38 % female 65.8 Age 51.0 (18-69)** Symptoms NR Training status Other	1	Isokinetic	Findings were inconclusive and require further research.
Slider 2013 United States[68]	RCT		N=24 %female 79.2 Age 24.0 (9.0) Symptoms NR Training status Recreational	2	Isokinetic; Concentric and eccentric	In general, subjects with an acute hamstring strain injury treated with either the PATS or PRES rehabilitation program demonstrated a similar degree of muscle recovery at the time of return to sport. Despite this, there were no subjects who exhibited complete resolution of injury on MRI, and 2 of the 4 subjects who reinjured themselves did so within the first 2 weeks after return to sport.
Stasinopoulos 2017 Cyprus[69]	RCT	Lateral elbow/tennis elbow	N= 34 % female 55.8 Age 43.7 (4.6) Symptoms 6 (NR) Training status Recreational	3	Eccentric only; 2*Concentric and eccentric	Eccentric training, eccentric-concentric training, and eccentric-concentric training combined with isometric contraction reduced pain and improved function at the end of the treatment and follow-up. The eccentric-concentric training combined with isometric contraction produced the largest

						effect at the end of the treatment and follow-up.
Stasinopoulos 2006 Greece[70]	Quasi-experimental	Lateral elbow/tennis elbow	N= 75 % female 38.6% Age 40.3 (5.8) Symptoms 5 (NR) Training status Other	1	Eccentric only	Cyriax Physiotherapy, a supervised exercise programme, and polarized polychromatic non-coherent light reduced pain and improved function at the end of the treatment and at any of the follow-up time points. The supervised exercise programme produced the largest effect in the short, intermediate and long term.
Stasinopoulos 2010 Greece[71]	Quasi-experimental	Lateral elbow/tennis elbow	N= 70 % female 52.9 Age 45.1 (5.8) Symptoms 5 (NR) Training status NR	2	2*Eccentric only	Supervised exercise programme is superior to home exercise programme to reduce pain and improve function in patients with LET at the end of the treatment and at the follow-up.
Stasinopoulos 2013 Greece[72]	RCT	Lateral elbow/tennis elbow	N= 60 % female 36.7 Age 48.0 (5.9) Symptoms 4.5 (NR) Training status Other	2	Isometric; Eccentric only	A specific supervised exercise programme is superior to a specific home exercise programme in reducing pain and improving function in patients with lateral epicondyle tendinopathy at the end of the treatment and at the 3 month follow-up.
Stefansson 2019 Iceland[73]	RCT	Achilles	N= 58 % female 20.0 Age NR Symptoms NR Training status Other	1	Eccentric only	Similar results for pressure massage and eccentric exercise. Combining pressure massage and eccentric exercise did not improve outcomes
Steunebrink 2013 Netherlands[74]	RCT	Patellar	N= 33 % female 24.2 Age 32.9 (10) Symptoms 11 (8) Training status	1	Resistance	Continuous topical GTN treatment in addition to an eccentric exercise programme does not improve clinical outcome compared to placebo patches and an eccentric

			Recreational			exercise programme in patients with chronic patellar tendinopathy.
Stevens 2014 United Kingdom[75]	RCT	Achilles	N= 28 % female 60.7 Age 48.7 (10.8) Symptoms 7.4 (4.0) Training status Other	2	2*Eccentric only	Performing a 6-week do-as-tolerated program of eccentric heel-drop exercises compared to the recommended 180 repetitions per day, did not lead to lesser improvement for individuals with midportion Achilles tendinopathy, based on VISA-A and VAS scores.
Svernlov 2001 Sweden[76]	Quasi-experimental	Lateral elbow/tennis elbow	N= 57 % female 61.3 Age 50.15 (NR) Symptoms 6.3 (NR) Training status Other	1	Eccentric only	Significant improvements observed for VAS and grip strength warrants clinical use of this regime.
Tonks 2007 United Kingdom[77]	RCT	Lateral elbow/tennis elbow	N= 34 % female NR Age 44.3 (7.1) Symptoms NR Training status Other	1	Isometric	Patients who received steroid injection were statistically significantly better for all outcome measures at follow up. No statistically significant effect of Physiotherapy nor interaction between Physiotherapy and injection was found.
Turgut 2017 Turkey[78]	RCT	Rotator cuff - subacromial impingement	N= 30 % female 46.7 Age 36.45 (17.5) Symptoms 6.28 (5.4) Training status Other	2	2*Concentric and eccentric	Progressive exercise training independent from specific scapular stabilization exercises provides decreased disability and pain severity in impingement syndrome. All groups showed improvement, however, there were no significant differences between the groups.
Vallés-Carrascosa 2018 Spain[79]	RCT	Rotator cuff - subacromial impingement	N= 22 % female 54 Age 59.0 (58.5-70.0)* Symptoms Training status	2	2*Eccentric only	Both rotator cuff eccentric exercise protocols with scapular stabilising and stretching of upper trapezius were equally effective in improving pain, function, and active ROM in the short-term in patients with

			Other			subacromial syndrome.
vanArk 2016 Australia[80]	RCT	Patellar	N= 19 % female 6.9 Age 23 (4.7) Symptoms 35.8 (33.8) Training status Recreational	2	Isometric; Concentric and eccentric	This study found favourable results for athletes with patellar tendinopathy without modification of the training. Both isometric and isotonic exercise programs reduced pain and improve function in athletes with patellar tendinopathy during a season.
Vinuesa-Montoya 2017 Spain[81]	RCT	Rotator cuff - subacromial impingement	N= 40 % female 26.8 Age 47.0 (9.0) Symptoms 6.2 (3.8) Training status Other	1	Concentric and eccentric	Cervicothoracic manipulative treatment with mobilisation plus exercise therapy may improve intensity of pain and ROM compared with home exercise alone.
Visnes 2005 Norway[82]	RCT	Patellar	N= 29 % female 38.5 Age 26.58 (NR) Symptoms 73.6 (62.3) Training status Performance	1	Eccentric only	There was no effect on knee function (VISA) from a 12-week program with eccentric training among a group of volleyball players with patellar tendinopathy who continued to train and compete during the treatment period. Whether the training would be effective if the patients did not participate in sports activity is not known.
Vuvan 2019 Australia[83]	RCT	Lateral elbow/tennis elbow	N= 39 % female 28 Age 48.5 (9) Symptoms 4 (NR) Training status Other	2	Isometric	Unsupervised isometric exercise was effective in improving pain and disability, but not perceived rating of change and pain-free grip strength when compared with wait-and-see at 8 wk. With only one of the three primary outcomes being significantly improved, it is doubtful if isometric exercises can be an efficacious standalone treatment.
Walther	RCT	Rotator cuff -	N= 60	2	Isometric	There were no statistically

2004 Germany[84]		subacromial impingement	% female 43.3 Age 50.7 (NR) Symptoms 27.3 (NR) Training status Other			significant differences among the groups. Guided self-training can lead to results similar to those of conventional Physiotherapy.
Wegener 2016 Australia[85]	RCT	Lateral elbow/tennis elbow	N= 40 % female 70 Age 49.52 (8.09) Symptoms NR Training status NR	1	Eccentric only	Whilst all groups improved on key outcomes, it is possible that exercise alone and/or natural recovery were responsible for improvements.
Wen 2011 United States[86]	RCT	Lateral elbow/tennis elbow	N= 28 % female 46.4 Age 46 (7.3) Symptoms 3.3 (2.2) Training status Other	1	Eccentric only	The authors were unable to show any statistical advantage to eccentric exercises for lateral epicondylosis compared with local modalities and stretching exercises.
Werner 2002 Germany[87]	RCT	Rotator cuff - subacromial impingement	N=20 % female 50 Age 51.75 (NR) Symptoms 27.5 Training status Other	2	Isometric	Strengthening of the centering muscles around the humeral head lead to positive outcomes for subacromial impingement. Self-training after instruction showed no difference to physiotherapist-supervised exercises.
Wiedmann 2017 Germany[88]	RCT	Achilles	N= 20 % female 65.0 Age 43.0 (6.0) Symptoms NR Training status Other	1	Eccentric only	Eccentric training improved the VISA-A and VAS scores after 12 weeks more than Physiotherapy treatment.
Yelland 2011 Australia[89]	RCT	Achilles	N= 43 % female NR Age 46.7 (NR)	1	Eccentric only	Prolotherapy and particularly eccentric loading exercises combined with prolotherapy gave

			Symptoms 17 (NR) Training status Other			more rapid improvements in Achilles tendinosis symptoms than eccentric loading exercises alone. Long term VISA-A scores were similar.
Young 2005 Australia[90]	RCT	Patellar	N= 17 % female 23.5 Age 27.3 (1.8) Symptoms NR Training status Performance	2	Eccentric only; Concentric and eccentric	Both exercise protocols improved pain and sporting function in volleyball players over 12 months. The decline squat protocol offers greater clinical gains during a rehabilitation programme for patellar tendinopathy in athletes who continue to train and play with pain.
Yu 2013 Korea (Republic of)[91]	Quasi-experimental	Achilles	N= 32 % female 0.0 Age 30.3 (1.6) Symptoms 11.7 (2.1) Training status Other	2	Eccentric only; Concentric only	Eccentric strengthening was more effective than concentric strengthening in reducing pain and improving function in patients with Achilles tendinopathy.

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SF6. Risk of Bias and confidence in cumulative evidence assessments

Supplementary table 6A. Risk of Bias assessments per study. Assessments were made for each outcome in a study with the mode value selected and presented here.

Author, Year (reference)*	**Random sequence generation**	**Allocation concealment**	**Blinding of participants /personnel**	**Blinding of outcome assessment**	**Incomplete outcome bias**	**Selective reporting**	**Other bias**
Alfredson et al 1998 (1)	High risk	Unclear	High risk	Unclear	Low risk	Unclear	High risk
Alfredson et al 1999 (2)	NA (quasi)	NA (quasi)	NA (quasi)	NA (quasi)	Low risk	Unclear	High risk
Arias-Buría et al 2015 (3)	Low risk	Low risk	High risk	Low risk	Low risk	Unclear	Low risk
Arias-Buría et al 2017 (4)	Low risk	Low risk	Unclear	Low risk	Unclear	Low risk	High risk
Bahr et al 2006 (5)	Low risk	Low risk	High risk	Low risk	Low risk	Unclear	Low risk
Balius et al 2016(6)	Low risk	Low risk	Unclear	Low risk	Low risk	Unclear	Low risk
Beyer et al 2015 (7)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk
Blume et al 2015 (8)	Unclear	Low risk	Low risk	Low risk	Low risk	Unclear	Low risk
Boudreau et al 2019 (9)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Breda et al 2020 (10)	Low risk	Low risk	High risk	Low risk	Low risk	High risk	High risk
Chaconas et al 2017 (11)	Low risk	Unclear	Unclear	Low risk	High risk	Unclear	High risk
Cheng et al 2007 (12)	High risk	High risk	Unclear	Unclear	Unclear	Unclear	High risk
Cho et al 2017 (13)	High risk	High risk	Unclear	Unclear	Low risk	Low risk	Unclea r
De Jonge et al 2008 (14)	Unclear	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
de Vos et al 2007 (15)	Low risk	Unclear	Low risk	Low risk	Unclear	Low risk	High risk
Dejaco et al 2017 (16)	Low risk	Low risk	Low risk	Low risk	Low risk	High risk	Low risk
Dimitrios et al 2012 (17)	NA (quasi)	NA (quasi)	Low risk	Low risk	Low risk	Unclear	High risk
Dupuis et al 2018 (18)	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	High risk
Ganderton et al 2018 (19)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk
Gatz et al 2020 (20)	Low risk	Low risk	Low risk	Low risk	Unclear	Unclear	High risk
Giray et al 2019 (21)	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	High risk
Hallgren et al 2014(22)	High risk	Low risk	High risk	Low risk	Unclear	Low risk	Low risk
Hallgren et al 2017 (23)	Unclear	Unclear	Low risk	Low risk	Low risk	Low risk	Low risk
Heron et al	Low risk	Low risk	Low risk	Low risk	High risk	High risk	Low

Author, Year (reference)*	**Random sequence generation**	**Allocation concealment**	**Blinding of participants /personnel**	**Blinding of outcome assessment**	**Incomplete outcome bias**	**Selective reporting**	**Other bias**
2017 (24)							risk
Hotta et al 2020 (25)	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	High risk
Johansson et al 2005 (26)	Low risk	Unclear	Unclear	Low risk	Low risk	Unclear	High risk
Jonsson 2009 (27)	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Ketola et al 2009 (28)	Low risk	Low risk	Unclear	Low risk	Low risk	Unclear	High risk
Knobloch et al 2007 (29)	Low risk	Low risk	Unclear	Unclear	High risk	Unclear	High risk
Knobloch et al 2007 (30)	Unclear	Unclear	High risk	Low risk	Unclear	Unclear	High risk
Knobloch et al 2008 (31)	Unclear	Low risk	Unclear	Unclear	Unclear	Unclear	High risk
Kongsgaard et al (32)	Low risk	Low risk	High risk	Low risk	Low risk	Unclear	Low risk
Kromer et al 2014 (33)	Low risk	Low risk	High risk	High risk	Low risk	Low risk	Low risk
Kromer et al 2013 (34)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Littlewood et al 2016 (35)	Low risk	Low risk	High risk	High risk	Unclear	Unclear	High risk
Luginbuhl et al 2008 (36)	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	High risk
Maenhout et al 2013 (37)	Unclear	High risk	High risk	High risk	Low risk	Unclear	Low risk
Mafi et al 2001 (38)	Low risk	Unclear	Unclear	Unclear	Unclear	Unclear	High risk
Manias et al 2006 (39)	High risk	High risk	High risk	High risk	Low risk	Unclear	Unclear
Martinez-Silvestrini et al 2005 (40)	Unclear	Unclear	Unclear	Unclear	Low risk	Unclear	High risk
Marzetti et al 2014 (41)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
McCormack et al 2016 (42)	Low risk	Low risk	Unclear	Unclear	Low risk	Low risk	Low risk
Mulligan et al 2016 (43)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear	High risk
Nørregaard et al 2007 (44)	Low risk	Low risk	Unclear	Unclear	Unclear	Unclear	High risk
Nowotny et al 2018 (45)	Low risk	Unclear	Low risk	Low risk	High risk	Unclear	High risk
Østerås et al 2010 (46)	Low risk	Low risk	High risk	High risk	Low risk	Unclear	High risk
Park et al 2010 (47)	Low risk	Unclear	Unclear	Unclear	Unclear	Unclear	High risk
Pearson et al 2012 (48)	Unclear	Unclear	High risk	Unclear	Low risk	Unclear	High risk
Pearson et al 2018 (49)	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	High risk

Author, Year (reference)*	**Random sequence generation**	**Allocation concealment**	**Blinding of participants /personnel**	**Blinding of outcome assessment**	**Incomplete outcome bias**	**Selective reporting**	**Other bias**
Pekyavas et al 2016 (50)	Low risk	Low risk	High risk	Low risk	Unclear	Unclear	Low risk
Petersen et al 2007 (51)	Low risk	Unclear	Unclear	Unclear	Unclear	Unclear	High risk
Peterson et al 2011 (52)	Low risk	Low risk	Unclear	High risk	Low risk	Low risk	Low risk
Peterson et al 2014 (53)	Low risk	Unclear	Low risk	High risk	Low risk	Low risk	Low risk
Praet et al 2019 (54)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear	Low risk
Rabusin et al 2020 (55)	Low risk	Low risk	High risk	High risk	Low risk	Low risk	High risk
Rio et al 2017 (56)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	High risk
Romero-Morales et al 2020 (57)	Unclear	Unclear	Unclear	Unclear	Low risk	Low risk	High risk
Rompe et al 2007 (58)	Low risk	Low risk	Unclear	Low risk	Low risk	Unclear	Low risk
Rompe et al 2008 (59)	Low risk	Low risk	Unclear	Low risk	Low risk	Unclear	Unclear
Rompe et al 2009 (60)	Unclear	Low risk	High risk	High risk	Low risk	Unclear	Low risk
Rompe et al 2009 (61)	Low risk	Low risk	High risk	Low risk	Low risk	Unclear	Low risk
Roos et al 2004 (62)	Low risk	Unclear	Unclear	Low risk	Low risk	Unclear	Low risk
Şenbursa et al 2011 (63)	Low risk	Unclear	Unclear	Unclear	Low risk	Unclear	Low risk
Sevier et al 2015 (64)	Low risk	Unclear	High risk	High risk	High risk	Unclear	High risk
Silbernagel et al 2001 (65)	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	High risk
Silbernagel et al 2007 (66)	Low risk	Low risk	High risk	High risk	Low risk	Unclear	Low risk
Simşek et al 2013 (67)	Unclear	Unclear	Unclear	Low risk	Unclear	Unclear	Unclear
Slider et al 2013 (68)	Low risk	Unclear	Low risk	Low risk	Low risk	Unclear	Unclear
Stasinopoulos 2013 (69)	High risk	High risk	High risk	Low risk	Low risk	Unclear	High risk
Stasinopoulos et al 2006(70)	NA (quasi)	NA (quasi)	Unclear	Low risk	Low risk	Unclear	High risk
Stasinopoulos et al 2010(71)	NA (quasi)	NA (quasi)	Low risk	Low risk	Low risk	Unclear	High risk
Stasinopoulos et al 2017(72)	Low risk	Unclear	Low risk	Low risk	Low risk	Unclear	High risk
Stefansson et al 2019 (73)	Low risk	Unclear	High risk	Low risk	High risk	Unclear	Low risk
Steunebrink et al 2013 (74)	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear	Low risk
Stevens et al	Unclear	Unclear	High risk	High risk	Unclear	Unclear	High

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Author, Year (reference)*	**Random sequence generation**	**Allocation concealment**	**Blinding of participants /personnel**	**Blinding of outcome assessment**	**Incomplete outcome bias**	**Selective reporting**	**Other bias**
2014 (75)							risk
Svernlov et al 2001 (76)	NA (quasi)	NA (quasi)	Unclear	Unclear	Unclear	Unclear	High risk
Tonks et al 2007 (77)	Low risk	Low risk	Low risk	High risk	High risk	Low risk	Low risk
Turgut et al 2017 (78)	Low risk	Unclear	Unclear	Unclear	High risk	Unclear	Low risk
Vallés-Carrascosa et al 2018 (79)	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	High risk
vanArk et al 2016 (80)	Low risk	Low risk	Low risk	Unclear	Unclear	Low risk	Low risk
Vinuesa-Montoya et al 2017 (81)	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	Low risk
Visnes et al 2005 (82)	Low risk	Low risk	High risk	Low risk	Unclear	Unclear	Unclear
Vuvan et al 2019 (83)	Low risk	Low risk	High risk	High risk	Low risk	Low risk	Low risk
Walther et al 2004 (84)	Unclear	Unclear	Unclear	Unclear	Low risk	Unclear	Unclear
Wegener et al 2016 (85)	Low risk	Low risk	High risk	Low risk	Low risk	Unclear	High risk
Wen et al 2011 (86)	Unclear	Unclear	Low risk	Unclear	High risk	Unclear	High risk
Werner et al 2002 (87)	Low risk	Unclear	Unclear	Unclear	Unclear	Unclear	High risk
Wiedmann et al 2017 (88)	Low risk	Low risk	Unclear	Unclear	Unclear	Unclear	High risk
Yelland et al 2011 (89)	Low risk	Low risk	High risk	Low risk	Low risk	Unclear	Low risk
Young et al 2005 (90)	Unclear	Unclear	High risk	Low risk	High risk	Unclear	High risk
Yu et al 2013 (91)	Low risk	Low risk	Low risk	Unclear	Low risk	Unclear	Unclear

*Included studies reference list in supplementary SF5-B. NA= not applicable

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Supplementary table 6B. Overall RoB and confidence in cumulative evidence assessment for moderator levels in meta-regression investigating resistance exercise intensity.

Moderator	**Model**	**Overall RoB**	**Inconsistency**	**Imprecision**	**Indirectness**	**Small study-effects**	**Confidence in Evidence**
Intensity: Body mass	All tendinopathies/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Intensity: Additional	All tendinopathies/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Intensity: Body mass	Achilles/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Intensity: Additional	Achilles / Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Intensity: Body mass	RCRSP/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Intensity: Additional	RCRSP/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Intensity: Body mass	Patellar/ Large-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Intensity: Additional	Patellar/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Intensity: Body mass	All tendinopathies/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Intensity: Additional	All tendinopathies/ Small -effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Intensity: Body mass	Achilles/ Small-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Intensity: Additional	Achilles / Small-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Intensity: Body mass	RCRSP / Small-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Intensity: Additional	RCRSP / Small-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate

Supplementary table 6C. Overall RoB and confidence in cumulative evidence assessment for moderator levels in meta-regression investigating resistance exercise frequency.

Moderator	Model	Overall RoB	Inconsistency	Imprecision	Indirectness	Small study-effects	Confidence in evidence
Frequency: Less than daily	All tendinopathies/ Large-effects	Low risk	High risk	High risk	Low risk	High risk	Low
Frequency: Daily	All tendinopathies/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: More than Daily	All tendinopathies/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: Less than daily	Achilles/ Large-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Frequency: Daily	Achilles/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Frequency: More than Daily	Achilles/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: Less than daily	RCRSP/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: Daily	RCRSP/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: More than Daily	RCRSP/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Frequency: Less than daily	All tendinopathies/ Small-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Frequency: Daily	All tendinopathies/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Frequency: More than Daily	All tendinopathies/ Small-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: Less than daily	Achilles/ Small-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Frequency: Daily	Achilles/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Frequency: More than Daily	Achilles/ Small-effects	High risk	High risk	Low risk	Low risk	High risk	Very low
Frequency: Less than daily	RCRSP/ Small-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Frequency: Daily	RCRSP/ Small-effects	Low risk	High risk	High risk	Low risk	High risk	Very low
Frequency: More than Daily	RCRSP/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low

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Supplementary table 6D. Overall RoB and confidence in cumulative evidence assessment for moderator levels in meta-regression investigating resistance exercise volume.

Moderator	Model	Overall RoB	Inconsistency	Imprecision	Indirectness	Small study-effects	Confidence in evidence
Volume: Low	All tendinopathies/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: High	All tendinopathies/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: Low	Achilles/ Large-effects	Low risk	High risk	High risk	Low risk	Low risk	Low
Volume: High	Achilles / Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: Low	RCRSP/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: High	RCRSP/ Large-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: Low	Patellar/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Volume: High	Patellar/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Volume: Low	Elbow/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Volume: High	Elbow/ Large-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Volume: Low	All tendinopathies/ Small-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: High	All tendinopathies/ Small-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: Low	RCRSP/ Small-effects	Low risk	Low risk	Low risk	Low risk	High risk	Moderate
Volume: High	RCRSP/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Volume: Low	Patellar/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low
Volume: High	Patellar/ Small-effects	Low risk	Low risk	High risk	Low risk	High risk	Low

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SF7 Moderator analyses comparing averaged pooled effect sizes

Supplementary table 7A. Moderator analysis comparing average pooled effect size for body weight interventions versus interventions including additional external load. Results presented across all tendinopathies and individual tendinopathies.

Moderator		Estimate of mean [95% CrI]	Probability	Study VPC [75% CrI]	Outcome VPC [75% CrI]	Measurement VPC [75% CrI]	Confidence in evidence
Large Effects (All tendinopathies)	Body mass 189 outcomes 33 treatment arms)	1.0 [0.68 to 1.4]	*p*(Body weight < Additional) = 0.976	0.78 [0.72 to 0.83]	0.15 [0.11 to 0.20]	0.03 [0.00 to 0.05]	Low
	Additional external (426 outcomes 78 treatment arms)	1.4 [1.2 to 1.7]					Moderate
Large Effects (Achilles)	Body weight (180 outcomes 18 treatment arms)	0.86 [0.52 to 1.2]	*p*(Body weight < Additional) = 0.998	0.77 [0.63 to 0.88]	0.16 [0.07 to 0.29]	0.06 [0.01 to 0.13]	Low
	Additional external (56 outcomes 17 treatment arms)	1.6 [1.2 to 2.1]					Low
Large Effects (RCSP)	Body weight (60 outcomes 7 treatment arms)	0.66 [0.28 to 1.0]	*p*(Body weight < Additional) = 0.980	0.45 [0.29 to 0.59]	0.50 [0.37 to 0.65]	0.05 [0.01 to 0.11]	Low
	Additional external (184 outcomes 27 treatment arms)	1.1 [0.92 to 1.3]					Moderate
Large Effects (Patellar)	Body weight (10 outcomes 3 treatment arms)	0.76 [0.40 to 0.97]	*p*(Body weight < Additional) = 0.900	0.51 [0.14 to 0.75]	0.46 [0.22 to 0.83]	0.01 [0.00 to 0.06]	Very Low
	Additional external (63 outcomes 16 treatment arms)	1.1 [0.67 to 1.4]					Low
Small Effects (All tendinopathies)	Body weight (98 outcomes 13 treatment arms)	0.36 [0.20 to 0.52]	*p*(Body weight < Additional) = 0.723	0.77 [0.70 to 0.83]	0.22 [0.16 to 0.42]	0.00 [0.00 to 0.01]	Low
	Additional external (266 outcomes 36 treatment arms)	0.44 [0.30 to 0.58]					Moderate

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Small Effects (Achilles)	Body weight (71 outcomes 6 treatment arms)	0.36 [-0.17 to 0.92]	*p*(Body weight < Additional) = 0.861	0.52 [0.33 to 0.71]	0.48 [0.29 to 0.66]	0.00 [0.00 to 0.02]	Very Low
	Additional external (43 outcomes 5 treatment arms)	0.76 [0.18 to 1.3]					Very Low
Small Effects (RCSP)	Body weight (14 outcomes 4 treatment arms)	0.48 [0.13 to 0.84]	*p*(Body weight < Additional) = 0.520	0.76 [0.63 to 0.86]	0.22 [0.13 to 0.35]	0.00 [0.00 to 0.01]	Very Low
	Additional external (151 outcomes 15 treatment arms)	0.48 [0.31 to 0.65]					Moderate

Large Effects: Effect sizes obtained from outcomes measuring: 1) Disability; 2) Pain on loading/activity; 3) Pain without further specification; 4) Function; and 5) Pain over a specified time. Small Effects: Effect sizes obtained from outcomes measuring: 1) Quality of Life; 2) Physical Functional Capacity

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Supplementary table 7B. Moderator analysis comparing average pooled effect size for different training frequencies. Results presented across all tendinopathies and individual tendinopathies.

Moderator		**Estimate of mean [95% CrI]**	**Probability**	**Study VPC [75% CrI]**	**Outcome VPC [75% CrI]**	**Measurement VPC [75% CrI]**	**Risk of Bias**
Large Effects (All tendinopathies)	Less than daily (188 outcomes 35 treatment arms)	1.8 [1.5 to 2.1]	*p*(Less than daily > Once per day) > 0.999	0.77 [0.71 to 0.82]	0.19 [0.15 to 0.25]	0.02 [0.00 to 0.06]	Low
	Once per day (160 outcomes 29 treatment arms)	1.1 [0.71 to 1.5]	*p*(Once per day < More than once per day) = 0.678				Moderate
	More than once per day (255 outcomes 46 treatment arms)	1.2 [0.90 to 1.5]	*p*(Less than daily > More than once per day) > 0.999				Moderate
Large Effects (Achilles)	Less than daily 10 outcomes 3 treatment arms)	2.2 [1.2 to 3.4]	*p*(Less than daily > Once per day) > 0.999	0.81 [0.69 to 0.88]	0.12 [0.05 to 0.23]	0.04 [0.00 to 0.11]	Very low
	Once per day (31 outcomes 9 treatment arms)	1.0 [0.48 to 1.6]	*p*(Once per day < More than once per day) = 0.709				Low
	More than once per day (125 outcomes 23 treatment arms)	1.2 [0.85 to 1.5]	*p*(Less than daily > More than once per day) = 0.975				Moderate
Large Effects (RCSP)	Less than daily (105 outcomes 14 treatment arms)	1.0 [0.70 to 1.4]	*p*(Less than daily > Once per day) = 0.753	0.49 [0.34 to 0.63]	0.44 [0.32 to 0.58]	0.07 [0.01 to 0.14]	Moderate
	Once per day (72 outcomes 11 treatment arms)	0.89 [0.51 to 1.3]	*p*(Once per day < More than once per day) = 0.954				Moderate
	More than once per day (64 outcomes 10 treatment arms)	1.4 [0.97 to 1.8]	*p*(Less than daily < More than once per day) > 0.896				Low
Small Effects (All tendinopathies)	Less than daily (134 outcomes 15 treatment arms)	0.75 [0.27 to 0.71]	*p*(Less than daily > Once per day) >0.999	0.69 [0.60 to 0.78]	0.30 [0.22 to 0.39]	0.00 [0.00 to 0.01]	Moderate
	Once per day (137 outcomes	0.34 [0.15 to 0.54]	*p*(Once per day < More than once per day) = 0.710				Moderate

	17 treatment arms)						
	More than once per day (88 outcomes 16 treatment arms)	0.42 [0.24 to 0.61]	*p*(Less than daily > More than once per day) =0.992				Low
Small Effects (Achilles)	Less than daily (26 outcomes 2 treatment arms)	0.80 [0.20 to 1.4]	*p*(Less than daily > Once per day) = 0.902	0.30 [0.13 to 0.52]	0.69 [0.47 to 0.86]	0.00 [0.00 to 0.03]	Very low
	Once per day (50 outcomes 4 treatment arms)	0.30 [-0.05 to 0.59]	*p*(Once per day > More than once per day) = 0.537				Low
	More than once per day (36 outcomes 6 treatment arms)	0.33 [0.01 to 0.60]	*p*(Less than daily > More than once per day) = 0.995				Moderate
Small Effects (RCSP)	Less than daily (87 outcomes 9 treatment arms)	0.59 [0.38 to 0.80]	*p*(Less than daily > Once per day) = 0.969	0.73 [0.58 to 0.83]	0.26 [0.15 to 0.39]	0.01 [0.00 to 0.05]	Moderate
	Once per day (46 outcomes 5 treatment arms)	0.28 [0.02 to 0.55]	*p*(Once per day > More than once per day) = 0.602				Very low
	More than once per day (32 outcomes 5 treatment arms)	0.32 [0.01 to 0.60]	*p*(Less than daily > More than once per day) = 0.902				Low

Large Effects: Effect sizes obtained from outcomes measuring: 1) Disability; 2) Pain on loading/activity; 3) Pain without further specification; 4) Function; and 5) Pain over a specified time. Small Effects: Effect sizes obtained from outcomes measuring: 1) Quality of Life; 2) Physical Functional Capacity

Supplementary table 7C. Moderator analysis comparing average pooled effect size for binary resistance volume categorisation. Results presented across all tendinopathies and individual tendinopathies.

Moderator		**Estimate of mean [95% CrI]**	**Probability**	**Study VPC [75% CrI]**	**Outcome VPC [75% CrI]**	**Measurement VPC [75% CrI]**	**Risk of Bias**
Large Effects (All tendinopathies)	Lower Volume (265 outcomes 49 treatment arms)	1.4 [1.1 to 1.7]	*p*(Higher volume < Lower volume) = 0.563	0.81 [0. 74 to 0.85]	0.17 [0.13 to 0.22]	0.02 [0.00 to 0.06]	Moderate
	Higher Volume (318 outcomes 57 treatment arms)	1.3 [1.1 to 1.6]					Moderate
Large Effects (Achilles)	Lower Volume (29 outcomes 3 treatment arms)	1.1 [0.15 to 2.1]	*p*(Higher volume > Lower volume) = 0.601	0.85 [0.73 to 0.92]	0.10 [0.04 to 0.20]	0.04 [0.00 to 0.11]	Low
	Higher Volume (129 outcomes 31 treatment arms)	1.2 [0.93 to 1.6]					Moderate
Large Effects (RCSP)	Lower Volume (164 outcomes 26 treatment arms)	0.97 [0.75 to 1.2]	*p*(Higher volume > Lower volume) = 0.989	0.48 [0.34 to 0.61]	0.43 [0.31 to 0.57]	0.08 [0.01 to 0.16]	Moderate
	Higher Volume (75 outcomes 7 treatment arms)	1.5 [1.1 to 1.9]					Moderate
Large Effects (Patellar)	Lower Volume (22 outcomes 7 treatment arms)	0.95 [0.37 to 1.5]	*p*(Higher volume > Lower volume) = 0.566	0.70 [0.38 to 0.86]	0.28 [0.12 to 0.59]	0.01 [0.00 to 0.05]	Low
	Higher Volume (43 outcomes 10 treatment arms)	1.0 [0.51 to 1.5]					Low
Large Effects (Lateral elbow)	Lower Volume (47 outcomes 12 treatment arms)	1.2 [0.32 to 1.8]	*p*(Higher volume > Lower volume) = 0.834	0.73 [0.57 to 0.84]	0.24 [0.14 to 0.39]	0.02 [0.00 to 0.04]	Low
	Higher Volume (71 outcomes 9 treatment arms)	1.6 [0.40 to 2.3]					Low
Small Effects (All tendinopathies)	Lower Volume (169 outcomes	0.56 [0.36 to 0.75]	*p*(Higher volume < Lower volume) = 0.886	0.77 [0.69 to 0.83]	0.23 [0.17 to 0.30]	0.00 [0.00 to 0.01]	Moderate

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	14 treatment arms)						
	Higher Volume (173 outcomes 12 treatment arms)	0.39 [0.19 to 0.58]					Moderate
Small Effects (RCSP)	Lower Volume (136 outcomes 14 treatment arms)	0.46 [0.28 to 0.64]	*p*(Higher volume > Lower volume) = 0.765	0.75 [0.60 to 0.86]	0.23 [0.13 to 0.37]	0.01 [0.00 to 0.03]	Moderate
	Higher Volume (20 outcomes 3 treatment arms)	0.60 [0.22 to 0.98]					Low
Small Effects (Lateral elbow)	Lower Volume (12 outcomes 5 treatment arms)	0.45 [0.05 to 0.82]	*p*(Higher volume < Lower volume) = 0.633	0.53 [0.08 to 0.84]	0.46 [0.15 to 0.90]	0.00 [0.00 to 0.02]	Low
	Higher Volume (39 outcomes 5 treatment arms)	0.38 [0.02 to 0.78]					Low

Large Effects: Effect sizes obtained from outcomes measuring: 1) Disability; 2) Pain on loading/activity; 3) Pain without further specification; 4) Function; and 5) Pain over a specified time. Small Effects: Effect sizes obtained from outcomes measuring: 1) Quality of Life; 2) Physical Functional Capacity