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Resistance Exercise for Lower Limb Tendinopathy: Protocol for a Systematic Review of Systematic Reviews Evaluating Effectiveness

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ABSTRACT

Review Objective: Perform a systematic review of systematic reviews to synthesize the best available evidence on the effectiveness of resistance exercise interventions for treating lower limb tendinopathies.

Introduction: Recent evidence suggests various forms of resistance exercise such as heavy slow resistance training, eccentric and isometric training are effective for treating lower limb tendinopathies. However, it is unclear which type of resistance training is most effective, with no systematic reviews of systematic reviews existing on the topic, and optimal treatment protocols and clinical recommendations are lacking.

Inclusion criteria: Systematic reviews of systematic reviews of randomised controlled trials evaluating the effectiveness of resistance exercise interventions any lower limb tendinopathy in adults will be included.

Methods: The authors will search for a wide range of sources to find published studies via EBSCOhost, including, but not limited to, MEDLINE, SPORTDiscus, CINAHL, Cochrane Central Register of Controlled Trials (CENTRAL), and Allied and Complementary Medicine Database (AMED). Studies published in a language other than English will only be considered if a translation is available. The AMSTAR tool will be used to assess methodological quality and internal validity of included systematic reviews, with a corrected cover area analysis to determine overlap of primary studies. Data synthesis will be conducted using a narrative synthesis.

Keywords: Exercise; Tendinopathy; Heavy slow resistance training: Resistance training; Tendon

INTRODUCTION

Tendinopathies of the lower limb such as Achilles and patellar tendinopathy can cause significant pain and functional limitations for individuals and collectively place a tremendous burden on society through high healthcare costs (Dean et al. 2017). In chronic tendinopathy, tendons experience morphological changes and can present with increased tendon thickness, fibril disorganization, and neovascularization due to angiogenesis caused by repetitive tendon microtrauma, commonly from loading activities such as exercise (Magnusson et al. 2019, Scott et al. 2008). Lower limb tendinopathy prevalence has been shown to be higher in athletes due to frequent jumping, landing, running and change of direction movements (Zwerver, Bredeweg, & van den Akker-Scheek, 2011). Collectively, tendinopathies can account for up to 30% of all sports injuries, with up to 22% of elite athletes having patellar tendinopathy at least once during their sporting careers (Skjong et al. 2012, Lian et al. 2005, Hopkins et al. 2016). Prevalence of plantar heel pain has been reported to be as high as 18% among runners (Janssen, van der Worp, Hensing, & Zwerver, 2018). The prevalence of Achilles and patellar tendinopathy have been reported to be as high as 23 and 45% in runners and elite male volleyball players, respectively (Sprague et al., 2018; Arnold, & Moody, 2018). In the general population incidence and prevalence of lower limb tendinopathies has been found to range from 7.0-11.8 and 10.5-16.6 per 1000 people, respectively (Albers et al., 2016; Riel et al., 2019). Tendinopathies are challenging to treat and are considered to have a multifactorial pathogenesis resulting from a range of extrinsic, intrinsic, and psychosocial factors (Steinmann et al., 2020; Mallows et al., 2017; Seitz et al., 2011). A range of common passive approaches are used in the treatment of tendinopathy including exercise, corticosteroid injections, shockwave therapy, laser therapy, ultrasound, platelet-rich plasma injections, topical glyceryl trinitrate, anti-inflammatory medications, manual therapy, and surgical intervention if appropriate (Challoumas et al. 2021, Cardoso et al., 2019).

Traditionally, the active treatment of choice for lower limb tendinopathies has been eccentric training, which has been popularised over the last two decades due to a

plethora of studies showing a 50-70% chance of clinical improvement following three to six months (Gaida et al. 2011, Malliaras et al. 2013). More recently, different types of resistance training have been investigated for lower limb tendinopathies with encouraging findings, such as HSRT and isometric training (Lim et al. 2018). Heavy slow resistance training (HSRT) involving both concentric and eccentric strengthening, has been shown to produce positive outcomes for lower limb tendinopathies including Achilles, patellar, and plantar heel pain (Beyer et al., 2015; Kongsgaard et al., 2009; Rathleff et al., 2015). However, it is currently unclear which type of resistance exercise is most effective for treating lower limb tendinopathies, with no systematic reviews of systematic reviews and meta-analysis having been conducted on the topic. A search in PROSPERO, The Cochrane Library and in PubMed was performed and identified no systematic reviews of systematic reviews and meta-analysis evaluating the effectiveness of resistance exercise interventions for lower limb tendinopathies. Therefore, the aim of this work is to conduct such a systematic review to synthesise the available evidence and inform recommendations regarding the optimal resistance training interventions for treating lower limb tendinopathy. The systematic review process will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and be conducted in accordance with the a priori protocol presented here and be registered in the PROSPERO database.

METHODS

Review question

What is the effectiveness of resistance exercise interventions for improving pain and function in lower limb tendinopathies as evaluated by systematic reviews?

Inclusion Criteria

Participants

The review will include studies that have included adults aged eighteen years or older with a diagnosis of a lower limb tendinopathy for any time duration. All lower limb tendinopathies will be included, such as gluteal, hamstring, patellar, Achilles, tibialis posterior and peroneal tendinopathy. Plantar heel pain or plantar fasciopathy will be included as it is considered to have a similar pathophysiology to tendinopathy and should therefore be treated in accordance with other lower limb tendinopathies according to recent literature (Riel et al. 2019). Any tendon condition characterised by common tendinopathy symptoms, in the absence of a full thickness tendon rupture will be considered for inclusion. A clinician's diagnosis based on verifiable clinical features including pain location and a symptom altering response to palpation or tendon loading with specific tendinopathy tests will be accepted for inclusion. Strategies to rule out other conditions through diagnostic imaging such as ultrasonography or magnetic resonance imaging confirmation of structural change will be permitted.

Interventions

This review will include systematic reviews of randomised controlled trials (RCTs) that have investigated the effectiveness of resistance exercise intervention for any lower limb tendinopathy. Any type of resistance training, including eccentric, concentric, isotonic, isometric, plyometric, heavy slow resistance training, general strength training or combinations of these exercise types will be considered. The resistance training may be used as a first or second-line intervention for tendinopathy and may be delivered in isolation or combined with other treatments. Resistance training may be delivered across a range of settings, delivered by health or exercise professionals. Resistance training interventions may be delivered in a supervised or unsupervised manner, using any methods for training progression and monitoring. Any home or healthcare setting including physiotherapy or podiatry clinics and departments, outpatient departments, primary care settings, specialist orthopaedic or surgical clinics, and rehabilitation clinics will be permitted.

Outcomes

Primary outcomes will include pain and function. Pain must be evaluated by any validated scale for tendinopathy such as the Visual Analogue Scale (VAS), Numeric Rating Scale (NRS), or verbal rating scales for pain will be included (Boonstra et al., 2008). Tendinopathy-specific patient-reported outcome measures will be included as they have been shown to be superior to more generic tools for some conditions, such as the Victoria Institute of Sport Assessment Achilles questionnaire (VISA-A), Victoria Institute of Sport Assessment Patella questionnaire (VISA-P), and Victoria Institute of Sport Assessment Gluteal questionnaire (VISA-G) (Korakakis et al. 2021). The Foot Function Index (FFI), and Foot and Ankle Ability Measure (FAAM) have both been validated for measuring function outcomes in interventions for plantar heel pain and will therefore be included (Martin et al. 2005; Budiman-Mak et al., 2013). Additional secondary outcomes that will be considered for inclusion if available include quality of life measures using validated scales such as the EQ-5D-5L and global rating of change (GRoC) scores (Herdman et al., 2011).

Types of studies

Systematic reviews will be included if they are systematic reviews of RCTs evaluating the effectiveness of any resistance exercise interventions for lower limb tendinopathy in adults. Systematic reviews written in English and published in a peer reviewed journal will only be considered. Studies published in a language other than English will only be considered if a translation is available as translation services are not available to the authors. To be included, studies must provide an adequate description of their methodology, involving an explicitly stated search strategy and search terms, eligibility criteria and methods for statistical analysis if appropriate. Systematic reviews will only be considered if they evaluate one or more lower limb tendinopathies as the primary pathology, and any type of resistance exercise as a primary or secondary intervention. Systematic reviews will be excluded if they are protocols or include study designs other than RCTs, include pathologies other than tendinopathy, assess pharmacological agents, or do not include resistance exercise in their evaluation.

Search strategy

The search strategy will seek to identify published and unpublished trials utilizing a three-step search strategy. An initial scoping search of Medline will be conducted, followed by analysis of text words contained in the title and abstract and article index terms. A comprehensive systematic search using all identified keywords and index terms will then be conducted using the following databases: Medline, CINAHL, AMED, SPORTDiscus, PEDro, and Cochrane CENTRAL. The search for unpublished studies will include EThOS Networked Digital Library of Theses and Dissertations and Google Scholar. The trial registers to be searched include: ClinicalTrials.gov, UK clinical trials gateway, and EU trials registry. Finally, in addition to the comprehensive search, supplementary searches will be undertaken from reviewing bibliographies of articles selected for critical appraisal and related systematic reviews to find those not initially identified. Databases will be searched from inception to January 1st, 2021.

Study selection

All identified citations from the systematic search will be uploaded into RefWorks (Proquest LLC), with duplicates removed. Two reviewers will independently screen the titles and abstracts of all studies obtained against the identified inclusion criteria. Full-text versions of eligible studies will be accessed and reviewed against the inclusion criteria. Studies will be removed from the screening process if the information provided does not meet the criteria. The details of studies meeting the criteria will be imported in to Covidence.

Assessment of methodological quality

The Assessment of Multiple Systematic Reviews (AMSTAR) tool will be used to assess the internal validity of each included systematic review. The AMSTAR tool can be used for the assessment of both the methodological quality and reporting techniques of systematic reviews (Pieper et al. 2015). Scoring for the AMSTAR tool will be categorized as low (0-4), medium (5-8), and high (9-11), with a maximum score of 11 available (Pollock et al. 2017, Shea et al. 2007, Pieper et al. 2018). Included studies will be critically appraised by two independent

reviewers, and any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Any primary overlap between systematic reviews will be assessed by extracting the names and authors of individual studies included in reviews. Using previous guidelines for assessing systematic review overlap, the corrected cover area (CCA) will be calculated. Values of less than 5% for CCA indicate minimal overlap while values greater than 15% indicate high levels of overlap between reviews (Hennessy et al. 2020). The results of critical appraisal will be reported in narrative form, and in a table. The critical appraisal results will be presented in a table and narrative form. All studies meeting inclusion criteria, regardless of their methodological quality, will undergo data extraction and synthesis and be included in the review.

Data extraction

Data will be extracted from papers included in the review using a standardised data extraction tool by two independent reviewers. The data extracted will include specific details relative to the interventions, comparators, resistance exercise type and parameters, populations, study methods, outcome measures, results, limitations, estimates of effect sizes, and outcomes of significance to the review question which include tendinopathy pain and function. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Authors of papers will be contacted to request missing or additional data, where required.

Data synthesis

Based on the data collected, a descriptive analysis of each included systematic review will be conducted to identify the effectiveness of resistance exercise interventions at improving patient-reported pain and function outcomes in each review.

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REFERENCES

ALBERS, I.S., ZWERVER, J., DIERCKS, R.L., DEKKER, J.H. and VAN DEN AKKER-SCHEEK, I., 2016. Incidence and prevalence of lower extremity tendinopathy in a Dutch general practice population: a cross sectional study. *BMC musculoskeletal disorders,* **17**, pp. 16-016-0885-2.

ARNOLD, M.J. and MOODY, A.L., 2018. Common Running Injuries: Evaluation and Management. *American Family Physician,* **97**(8), pp. 510-516.

BEYER, R., KONGSGAARD, M., HOUGS KJAER, B., OHLENSCHLAEGER, T., KJAER, M. and MAGNUSSON, S.P., 2015. Heavy Slow Resistance Versus Eccentric Training as Treatment for Achilles Tendinopathy: A Randomized Controlled Trial. *The American Journal of Sports Medicine,* **43**(7), pp. 1704-1711.

BOONSTRA, A.M., SCHIPHORST PREUPER, H.R., RENEMAN, M.F., POSTHUMUS, J.B. and STEWART, R.E., 2008. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. *International journal of rehabilitation research.Internationale Zeitschrift fur Rehabilitationsforschung.Revue internationale de recherches de readaptation,* **31**(2), pp. 165-169.

BUDIMAN-MAK, E., CONRAD, K.J., MAZZA, J. and STUCK, R.M., 2013. A review of the foot function index and the foot function index - revised. *Journal of foot and ankle research,* **6**(1), pp. 5-1146-6-5.

CARDOSO, T.B., PIZZARI, T., KINSELLA, R., HOPE, D. and COOK, J.L., 2019. Current trends in tendinopathy management. *Best practice & research.Clinical rheumatology,* **33**(1), pp. 122-140.

CHALLOUMAS, D., PEDRET, C., BIDDLE, M., NG, N.Y.B., KIRWAN, P., COOPER, B., NICHOLAS, P., WILSON, S., CLIFFORD, C. and MILLAR, N.L., 2021. Management of patellar tendinopathy: a systematic review and network meta-analysis of randomised studies. *BMJ open sport & exercise medicine,* **7**(4), pp. e001110.

DEAN, B.J.F., DAKIN, S.G., MILLAR, N.L. and CARR, A.J., 2017. Review: Emerging concepts in the pathogenesis of tendinopathy. *The surgeon : journal of the Royal Colleges of Surgeons of Edinburgh and Ireland,* **15**(6), pp. 349-354.

GAIDA, J.E. and COOK, J., 2011. Treatment options for patellar tendinopathy: critical review. *Current sports medicine reports,* **10**(5), pp. 255-270.

HENNESSY, E.A. and JOHNSON, B.T., 2020. Examining overlap of included studies in meta-reviews: Guidance for using the corrected covered area index. *Research synthesis methods,* **11**(1), pp. 134-145.

HERDMAN, M., GUDEX, C., LLOYD, A., JANSSEN, M., KIND, P., PARKIN, D., BONSEL, G. and BADIA, X., 2011. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation,* **20**(10), pp. 1727-1736.

HOPKINS, C., FU, S.C., CHUA, E., HU, X., ROLF, C., MATTILA, V.M., QIN, L., YUNG, P.S. and CHAN, K.M., 2016. Critical review on the socio-economic impact of tendinopathy. *Asia-Pacific journal of sports medicine, arthroscopy, rehabilitation and technology,* **4**, pp. 9-20.

JANSSEN, I., VAN DER WORP, H., HENSING, S. and ZWERVER, J., 2018. Investigating Achilles and patellar tendinopathy prevalence in elite athletics. *Research in sports medicine (Print),* **26**(1), pp. 1-12.

KONGSGAARD, M., KOVANEN, V., AAGAARD, P., DOESSING, S., HANSEN, P., LAURSEN, A.H., KALDAU, N.C., KJAER, M. and MAGNUSSON, S.P., 2009.

Corticosteroid injections, eccentric decline squat training and heavy slow resistance training in patellar tendinopathy. *Scandinavian Journal of Medicine & Science in Sports,* **19**(6), pp. 790-802.

KORAKAKIS, V., WHITELEY, R., KOTSIFAKI, A., STEFANAKIS, M., SOTIRALIS, Y. and THORBORG, K., 2021. A systematic review evaluating the clinimetric properties of the Victorian Institute of Sport Assessment (VISA) questionnaires for lower limb tendinopathy shows moderate to high-quality evidence for sufficient reliability, validity and responsiveness-part II. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA,* **29**(9), pp. 2765-2788.

LIAN, O.B., ENGEBRETSEN, L. and BAHR, R., 2005. Prevalence of jumper's knee among elite athletes from different sports: a cross-sectional study. *The American Journal of Sports Medicine,* **33**(4), pp. 561-567.

MAGNUSSON, S.P. and KJAER, M., 2019. The impact of loading, unloading, ageing and injury on the human tendon. *The Journal of physiology,* **597**(5), pp. 1283-1298.

MALLIARAS, P., BARTON, C.J., REEVES, N.D. and LANGBERG, H., 2013. Achilles and patellar tendinopathy loading programmes : a systematic review comparing clinical outcomes and identifying potential mechanisms for effectiveness. *Sports medicine (Auckland, N.Z.),* **43**(4), pp. 267-286.

MALLOWS, A., DEBENHAM, J., WALKER, T. and LITTLEWOOD, C., 2017. Association of psychological variables and outcome in tendinopathy: a systematic review. *British journal of sports medicine,* **51**(9), pp. 743-748.

MARTIN, R.L., IRRGANG, J.J., BURDETT, R.G., CONTI, S.F. and VAN SWEARINGEN, J.M., 2005. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot & ankle international,* **26**(11), pp. 968-983.

PIEPER, D., BUECHTER, R.B., LI, L., PREDIGER, B. and EIKERMANN, M., 2015. Systematic review found AMSTAR, but not R(evised)-AMSTAR, to have good measurement properties. *Journal of clinical epidemiology,* **68**(5), pp. 574-583.

PIEPER, D., KOENSGEN, N., BREUING, J., GE, L. and WEGEWITZ, U., 2018. How is AMSTAR applied by authors - a call for better reporting. *BMC medical research methodology,* **18**(1), pp. 56-018-0520-z.

POLLOCK, M., FERNANDES, R.M. and HARTLING, L., 2017. Evaluation of AMSTAR to assess the methodological quality of systematic reviews in overviews of reviews of healthcare interventions. *BMC medical research methodology,* **17**(1), pp. 48-017-0325-5.

RATHLEFF, M.S., MOLGAARD, C.M., FREDBERG, U., KAALUND, S., ANDERSEN, K.B., JENSEN, T.T., AASKOV, S. and OLESEN, J.L., 2015. High-load strength training improves outcome in patients with plantar fasciitis: A randomized controlled trial with 12-month follow-up. *Scandinavian Journal of Medicine & Science in Sports,* **25**(3), pp. e292-300.

RIEL, H., JENSEN, M.B., OLESEN, J.L., VICENZINO, B. and RATHLEFF, M.S., 2019. Self-dosed and pre-determined progressive heavy-slow resistance training have similar effects in people with plantar fasciopathy: a randomised trial. *Journal of physiotherapy,* **65**(3), pp. 144-151.

RIEL, H., LINDSTROM, C.F., RATHLEFF, M.S., JENSEN, M.B. and OLESEN, J.L., 2019. Prevalence and incidence rate of lower-extremity tendinopathies in a Danish general practice: a registry-based study. *BMC musculoskeletal disorders,* **20**(1), pp. 239-019-2629-6.

SCOTT, A., LIAN, O., BAHR, R., HART, D.A., DURONIO, V. and KHAN, K.M., 2008. Increased mast cell numbers in human patellar tendinosis: correlation with symptom duration and vascular hyperplasia. *British journal of sports medicine,* **42**(9), pp. 753-757.

SEITZ, A.L., MCCLURE, P.W., FINUCANE, S., BOARDMAN, N.D.,3RD and MICHENER, L.A., 2011. Mechanisms of rotator cuff tendinopathy: intrinsic, extrinsic, or both? *Clinical biomechanics (Bristol, Avon),* **26**(1), pp. 1-12.

SHEA, B.J., GRIMSHAW, J.M., WELLS, G.A., BOERS, M., ANDERSSON, N., HAMEL, C., PORTER, A.C., TUGWELL, P., MOHER, D. and BOUTER, L.M., 2007. Development of AMSTAR: a measurement tool to assess the methodological

quality of systematic reviews. *BMC medical research methodology,* **7**, pp. 10-2288-7-10.

SKJONG, C.C., MEININGER, A.K. and HO, S.S., 2012. Tendinopathy treatment: where is the evidence? *Clinics in sports medicine,* **31**(2), pp. 329-350.

SPRAGUE, A.L., SMITH, A.H., KNOX, P., POHLIG, R.T. and GRAVARE SILBERNAGEL, K., 2018. Modifiable risk factors for patellar tendinopathy in athletes: a systematic review and meta-analysis. *British journal of sports medicine,* **52**(24), pp. 1575-1585.

STEINMANN, S., PFEIFER, C.G., BROCHHAUSEN, C. and DOCHEVA, D., 2020. Spectrum of Tendon Pathologies: Triggers, Trails and End-State. *International journal of molecular sciences,* **21**(3), pp. 10.3390/ijms21030844.

ZWERVER, J., BREDEWEG, S.W. and VAN DEN AKKER-SCHEEK, I., 2011. Prevalence of Jumper's knee among nonelite athletes from different sports: a cross-sectional survey. *The American Journal of Sports Medicine,* **39**(9), pp. 1984-1988.