

TENDINOPATHY RESEARCH UPDATE - OCTOBER 2012

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NORMAL TENDON & PATHOLOGY

J R Soc Interface. 2012 Nov 7;9(76):3108-17. Epub 2012 Jul 4.

Specialization of tendon mechanical properties results from interfascicular differences.

Thorpe CT, Udeze CP, Birch HL, Clegg PD, Screen HR.

Abstract

Tendons transfer force from muscle to bone. Specific tendons, including the equine superficial digital flexor tendon (SDFT), also store and return energy. For efficient function, energy-storing tendons need to be more extensible than positional tendons such as the common digital extensor tendon (CDET), and when tested in vitro have a lower modulus and failure stress, but a higher failure strain. It is not known how differences in matrix organization contribute to distinct mechanical properties in functionally different tendons. We investigated the properties of whole tendons, tendon fascicles and the fascicular interface in the high-strain energy-storing SDFT and low-strain positional CDET. Fascicles failed at lower stresses and strains than tendons. The SDFT was more extensible than the CDET, but SDFT fascicles failed at lower strains than CDET fascicles, resulting in large differences between tendon and fascicle failure strain in the SDFT. At physiological loads, the stiffness at the fascicular interface was lower in the SDFT samples, enabling a greater fascicle sliding that could account for differences in tendon and fascicle failure strain. Sliding between fascicles prior to fascicle extension in the SDFT may allow the large extensions required in energy-storing tendons while protecting fascicles from damage.

Int J Exp Pathol. 2012 Oct;93(5):319-31. doi: 10.1111/j.1365-2613.2012.00829.x.

Heterotopic mineralization (ossification or calcification) in tendinopathy or following surgical tendon trauma.

O'Brien EJ, Frank CB, Shrive NG, Hallgrímsson B, Hart DA.

Abstract

Heterotopic tendon mineralization (ossification or calcification), which may be a feature of tendinopathy or which may develop following surgical trauma (repair or graft harvest), has not received much attention. The purpose of this article is to review the prevalence, mechanisms and consequences of heterotopic tendon mineralization and to identify the gaps in our current understanding. We focus on endochondral heterotopic ossification and draw on knowledge of the mechanisms of this process in other tissues and conditions. Finally, we introduce a novel murine Achilles tendon needle injury model, which will enable us to further study the mechanisms and biomechanical consequences of tendon mineralization.

J Shoulder Elbow Surg. 2012 Feb;21(2):238-44.

The role of nitric oxide in tendon healing.

Bokhari AR, Murrell GA.

Abstract

Nitric oxide (NO) is a small free radical that is generated by a family of enzymes called the nitric oxide synthases (NOS). There are 3 isoforms of NOS: endothelial NOS (eNOS), brain or neuronal NOS (bNOS), and inducible NOS (iNOS). In experiments performed during the last 20 years, we have shown that NO is induced by all 3 isoforms of NOS after tendon injury and that NOS activity is upregulated in tendinopathy. In normal uninjured tendons, there is very little NOS activity. In injured rat and human tendons, NOS activity was found in healing fibroblasts in a temporal fashion. In animal models, competitive inhibition of NOS resulted in reduced tendon healing, whereas the addition of NO resulted in enhanced tendon healing. In cultured human cells, the addition of NO via chemical means and adenovirus transfection resulted in enhanced collagen synthesis. We performed 3 randomized, double-blinded clinical trials that demonstrated a significant positive beneficial effect of NO treatment on clinical symptoms and function in patients with Achilles tendinopathy, tennis elbow, and supraspinatus tendonitis. NO was delivered via glyceryl trinitrate (GTN) patches. We also conducted a 3-year prospective follow-up that demonstrated significant long-term efficacy of GTN patches in treating noninsertional Achilles tendinopathy. In a 5-year prospective comparison treating lateral epicondylitis,

we found no additional benefits of GTN vs placebo at 5 years. The use of a new GTN patch, OrthoDerm, demonstrated no evidence for efficacy in treating chronic lateral epicondylitis.

J Orthop Res. 2012 Nov;30(11):1719-24. doi: 10.1002/jor.22144. Epub 2012 May 15.

The apoptosis pathway and the genetic predisposition to Achilles tendinopathy.

Nell EM, van der Merwe L, Cook J, Handley CJ, Collins M, September AV.

Abstract

Achilles tendinopathy (AT) is a degenerative condition for which several risk factors have been implicated including components of the inflammatory pathway. The aim was to assess functional variants within genes encoding components of the apoptosis signaling cascade and the effectiveness of a polygenic apoptosis profile to capture tendinopathy (TEN) risk. A total of 358 unaffected control (CON) participants [159 South Africa (SA CON) and 199 Australia (AUS CON)] and 166 affected AT (TEN) participants (87 SA TEN and 79 AUS TEN) were genotyped for four variants [CASP8 (rs384129), CASP8 (rs1045485), NOS3 (rs1799983), and NOS2 (rs2779249)]. Logistic regression was used to derive risk models for AT. A receiver operator characteristic (ROC) curve was plotted to determine the effectiveness of a model to capture AT risk. This study indicates the independent association of CASP8_rs1045485 and CASP8_rs384129 as well as their haplotype with AT risk and the identification of an optimal model which included genetic loci CASP8_rs384129 and CASP8_rs1045485 together with sex to capture AT risk in both SA and AUS. Collectively, these results further implicate the apoptosis signaling cascade as one of the biological pathways involved in the development of AT.

Orthopaedic Research Society. Published by Wiley Periodicals, Inc. J Orthop Res 30:1719-1724, 2012.

Ann Rheum Dis. 2012 Feb;71(2):302-10. Epub 2011 Oct 4.

Hypoxia: a critical regulator of early human tendinopathy.

Millar NL, Reilly JH, Kerr SC, Campbell AL, Little KJ, Leach WJ, Rooney BP, Murrell GA, McInnes IB.

Abstract

OBJECTIVES:

To seek evidence for the role of hypoxia in early human tendinopathy, and thereafter to explore mechanisms whereby tissue hypoxia may regulate apoptosis, inflammatory mediator expression and matrix regulation in human tenocytes.

METHODS:

Fifteen torn supraspinatus tendon (established pathology) and matched intact subscapularis tendon (representing 'early pathology') biopsies were collected from patients undergoing arthroscopic shoulder surgery. Control samples of the subscapularis tendon were collected from 10 patients undergoing arthroscopic stabilisation surgery. Markers of hypoxia were quantified by immunohistochemical methods. Human tendon-derived primary cells were derived from hamstring tendon tissue obtained during hamstring tendon anterior cruciate ligament reconstruction. The impact of hypoxia upon tenocyte biology ex vivo was measured using quantitative real-time PCR, multiplex cytokine assays, apoptotic proteomic profiling, immunohistochemistry and annexin V fluorescence-activated cell sorter staining.

RESULTS:

Increased expression of hypoxia-inducible factor 1 α , Bcl-2 and clusterin was detected in subscapularis tendon samples compared with both matched torn samples and non-matched control samples ($p<0.01$). Hypoxic tenocytes exhibited increased production of proinflammatory cytokines ($p<0.001$), altered matrix regulation ($p<0.01$) with increased production of collagen type III operating through a mitogen-activated protein kinase-dependent pathway. Finally, hypoxia increased the expression of several mediators of apoptosis and thereby promoted tenocyte apoptosis.

CONCLUSION:

Hypoxia promotes the expression of proinflammatory cytokines, key apoptotic mediators and drives matrix component synthesis towards a collagen type III profile by human tenocytes. The authors propose hypoxic cell injury as a critical pathophysiological mechanism in early tendinopathy offering novel therapeutic opportunities in the management of tendon disorders.

AETIOLOGY

Clin J Sport Med. 2012 Mar;22(2):157-9.

Foot posture and patellar tendon pain among adult volleyball players.

de Groot R, Malliaras P, Munteanu S, Payne C, Morrissey D, Maffulli N.

Abstract**OBJECTIVE:**

We hypothesized that individuals with a normal foot posture would be less likely to experience patellar tendon pain and pathology than those with a pronated or supinated foot.

DESIGN:

Observational study.

SETTING:

Field-based study among competing athletes.

PARTICIPANTS:

Volleyball players competing in the Victorian State League, Australia.

ASSESSMENT OF RISK FACTORS:

Patellar tendinopathy (PT) is common in sports involving running and jumping and can severely limit athletes' ability to compete. Several studies have investigated potential etiological factors for the development of PT, but little is known about the association between PT and foot posture.

MAIN OUTCOME MEASURES:

Static foot posture index (FPI), patellar tendon pain during single-leg decline squatting, and gray scale ultrasound imaging were measured in 78 recreational to elite volleyball players (48 men and 30 women).

RESULTS:

Men with patellar tendon pain were more likely to have a normal foot posture and men without pain were more likely to be pronated according to the FPI ($P < 0.05$). Women showed no association between FPI and pain or imaging ($P > 0.05$).

CONCLUSIONS:

Men with a normal foot posture were more likely to have PT compared to men with a pronated foot type.

Br J Sports Med. 2012 Mar;46(3):163-8. Epub 2011 Nov 22.

Is compressive load a factor in the development of tendinopathy?

Cook JL, Purdam C.

Abstract

Tendons are designed to take tensile load, but excessive load can cause overuse tendinopathy. Overuse tendinopathy results in extensive changes to the cells and extracellular matrix, resulting in activated cells, increase in large proteoglycans and a breakdown of the collagen structure. Within these pathological changes, there are areas of fibrocartilaginous metaplasia, and mechanotransduction models suggest that this response could be due to compressive load. As load management is a cornerstone of treating overuse tendinopathy, defining the effect of tensile and compressive loads is important in optimising the clinical management of tendinopathy. This paper examines the potential role of compressive loads in the onset and perpetuation of tendinopathy, and reviews the anatomical, epidemiological and clinical evidence that supports consideration of compressive loads in overuse tendinopathy.

Br J Sports Med. 2012 Sep;46(12):888-92. Epub 2012 Apr 30.

The relationship of femoral neck shaft angle and adiposity to greater trochanteric pain syndrome in women.**A case control morphology and anthropometric study.**

Fearon A, Stephens S, Cook J, Smith P, Neeman T, Cormick W, Scarvell J.

Abstract**OBJECTIVE:**

To evaluate if pelvic or hip width predisposed women to developing greater trochanteric pain syndrome (GTPS).

DESIGN:

Prospective case control study.

PARTICIPANTS:

Four groups were included in the study: those gluteal tendon reconstructions (n=31, GTR), those with conservatively managed GTPS (n=29), those with hip osteoarthritis (n=20, OA) and 22 asymptomatic participants (ASC).

METHODS:

Anterior-posterior pelvic x-rays were evaluated for femoral neck shaft angle; acetabular index, and width at the lateral acetabulum, and the superior and lateral aspects of the greater trochanter. Body mass index, and waist, hip and greater trochanter girth were measured. Data were analysed using a one-way analysis of variance (ANOVA; posthoc Scheffe analysis), then multivariate analysis.

RESULTS:

The GTR group had a lower femoral neck shaft angle than the other groups ($p=0.007$). The OR (95% CI) of having a neck shaft angle of less than 134°, relative to the ASC group: GTR=3.33 (1.26 to 8.85); GTPS=1.4 (0.52 to 3.75); OA=0.85 (0.28 to 2.61). The OR of GTR relative to GTPS was 2.4 (1.01 to 5.6). No group difference was found for acetabular or greater trochanter width. Greater trochanter girth produced the only anthropometric group difference (mean (95% CI) in cm) GTR=103.8 (100.3 to 107.3), GTPS=105.9 (100.2 to 111.6), OA=100.3 (97.7 to 103.9), ASC=99.1 (94.7 to 103.5), (ANOVA: $p=0.036$). Multivariate analysis confirmed adiposity is associated with GTPS.

Scand J Med Sci Sports. 2012 Oct;22(5):627-634. doi: 10.1111/j.1600-0838.2010.01287.x. Epub 2011 Mar 16.

Could tendinosis be involved in osteoarthritis?

Meknas K, Johansen O, Steigen SE, Olsen R, Jørgensen L, Kartus J.

Abstract

Ten patients, age 60 (48-75 years), with osteoarthritis (OA) of the hip and 10 patients, age 82.5 (60-90 years), with fracture of the collum femoris (FCF; minimum Garden stage III) underwent an open biopsy procedure from the internal obturator tendon in conjunction with a total hip replacement. The histological evaluation revealed that all tendon samples in the OA group revealed scar tissue; the corresponding was found in 50% of patients in the FCF group ($P=0.02$). There were also more GAGs ($P=0.023$) and calcium deposits ($P=0.001$) in the samples from the OA group. The ultrastructural evaluation revealed fewer small and medium-sized fibrils ($P=0.001$) and more non-collagenous extracellular matrix (ECM) ($P=0.003$) in the OA group. Taken together, the samples from the internal obturator tendon in the OA group revealed a more degenerative appearance with more scar tissue, change in fibril diameter distribution and more non-collagenous ECM. Our findings suggest that OA and periarticular tendinopathy are closely linked. Further research is needed to determine whether musculotendinous changes in the deep rotators are sequelae of joint pathology, or a contributing factor in the development of degenerative joint change.

DIAGNOSIS, ASSESSMENT

Scand J Med Sci Sports. 2012 Jul 26. doi: 10.1111/j.1600-0838.2012.01511.x. [Epub ahead of print]

Effects of tendon viscoelasticity in Achilles tendinosis on explosive performance and clinical severity in athletes.

Wang HK, Lin KH, Su SC, Shih TT, Huang YC.

Abstract

The aim was to compare viscoelastic properties of Achilles tendons between legs in elite athletes with unilateral tendinosis, and to investigate relationships between the properties and explosive performance and clinical severity. Seventeen male athletes (mean \pm standard deviation age, 27.3 ± 2.0 years) who had unilateral, chronic middle-portion tendinopathy of the Achilles tendon were assessed by the Victorian Institute of Sport Assessment questionnaire, measurements of tendon viscoelastic properties, voluntary electromechanical delay (EMD), normalized rate of force development (RFD), and one-leg hopping distance. Compared with the non-injured leg, the tendinopathic leg showed reduced tendon stiffness (-19.2%, $P < 0.001$), greater mechanical hysteresis (+21.2%, $P = 0.004$), lower elastic energy storage and release (-14.2%, $P = 0.002$ and -19.1%, $P < 0.001$), lower normalized RFD at one-fourth (-16.3%, $P = 0.02$), 2/4 (-17.3%, $P = 0.006$), and three-fourths maximal voluntary contraction (-13.7%, $P = 0.02$), longer soleus and medial gastrocnemius voluntary EMD (+26.9%, $P = 0.009$ and +24.0%, $P = 0.004$), and shorter hopping distances (-34.1%, $P < 0.001$). Tendon stiffness was correlated with normalized RFD, voluntary EMD in the medial gastrocnemius, and hopping distances (r ranged from -0.35 to 0.64, $P < 0.05$). Hysteresis was correlated to the soleus voluntary EMD and hopping distances ($r = 0.42$ and -0.39, $P < 0.05$). We concluded that altered tendon viscoelastic properties in Achilles tendinosis affect explosive performance in athletes.

IMAGING

Med Sci Sports Exerc. 2012 Feb;44(2):199-205.

Prognostic value of Achilles tendon Doppler sonography in asymptomatic runners.

Hirschmüller A, Frey V, Konstantinidis L, Baur H, Dickhuth HH, Südkamp NP, Helwig P.

Abstract

INTRODUCTION:

Midportion Achilles tendinopathy (MPT) is a common problem in running athletes. Nevertheless, its etiology is not fully understood, and no valid prognostic criterion to predict the development of MPT could be identified to date. The purpose of the present study, therefore, was to evaluate whether power Doppler ultrasonography (PDU) is a suitable method to identify a predisposition to MPT in yet asymptomatic runners.

METHODS:

At 23 major running events, 634 asymptomatic long-distance runners were tested for Achilles tendon thickness, vascularization, and structural abnormalities using a high-resolution PDU device (Toshiba Aplio SSA-770A/80, 12 MHz). In addition, their medical history and anthropometric data were documented. All subjects were contacted 6 and 12 months later and asked about any new symptoms. The collected anamnestic, anthropometric, and ultrasonographic data were subjected to regression analysis to determine their predictive value concerning the manifestation of midportion Achilles tendon complaints ($P < 0.05$).

RESULTS:

The highest odds ratio (OR) for manifestation of MPT within 1 yr was found for intratendinous blood flow ("neovascularization," OR = 6.9, $P < 0.001$). An increased risk was also identified for subjects with a positive history of Achilles tendon complaints (OR = 3.8, $P < 0.001$). A third relevant parameter, just above the level of significance, was a spindle-shaped thickening of the tendon on PDU (Wald $\chi^2 = 3.42$).

CONCLUSIONS:

PDU detection of intratendinous microvessels in the Achilles tendons of healthy runners seems to be a prognostically relevant factor concerning the manifestation of symptomatic MPT. This finding lays the foundation for an early identification of a predisposition to MPT as well as prophylactic intervention in as yet asymptomatic runners.

Am J Sports Med. 2012 Mar;40(3):548-55. Epub 2012 Feb 9.

Associations between abnormal ultrasound color Doppler measures and tendon pain symptoms in badminton players during a season: a prospective cohort study.

Boesen AP, Boesen MI, Torp-Pedersen S, Christensen R, Boesen L, Hölmich P, Nielsen MB, Koenig MJ, Hartkopp A, Ellegaard K, Bliddal H, Langberg H.

Abstract**BACKGROUND:**

Color Doppler ultrasound is widely used to examine intratendinous flow in individuals with overuse tendon problems, but the association between color Doppler and pain is still unclear.

HYPOTHESIS:

Intratendinous flow is present and associated with pain in badminton players, and intratendinous flow and pain increase during a badminton season.

STUDY DESIGN:

Cohort study (prognosis); Level of evidence, 2.

METHODS:

Ninety-five semiprofessional badminton players were included in the study at a tournament at the start of the badminton season. All players were interviewed regarding pain. The anterior knee tendons and Achilles tendons were studied. Each tendon was scored using a quantitative grading system (grades 0-5) and a qualitative scoring system (color fraction) using color Doppler ultrasound. Eight months later, 86 of the players (91%) were retested by the same investigators during an equivalent badminton tournament (including 1032 tendon regions; 86 players with 4 tendons each with 3 regions), thus forming the study group.

RESULTS:

At the start of the season, 24 players (28%) experienced pain in 37 tendons (11%), and at the end of the season, 31 players (36%) experienced pain in 51 tendons (15%), which was a statistically significant increase ($P = .0002$). Abnormal flow was found in 230 tendon regions in 71 players (83%) at the start of the season compared with 78 tendon regions in 41 players (48%) at the follow-up. The decrease in abnormal flow was statistically significant ($P < .0001$). Of the 37 painful tendons at the start of the season, 25 had abnormal flow (68%). In contrast, 131 tendons (85%) with abnormal flow at the start of the season were pain free. At the end of the season, 18 of the 51 painful tendons (35%) had abnormal flow. Ninety-six of the 131 pain-free tendons (73%) with abnormal flow at the start of the season were normalized (no pain and normal flow) at the end of the season.

CONCLUSION:

It was not possible to verify any association between intratendinous flow and pain at the start of the season or at the follow-up (end of the season). Intratendinous flow at the start of the season could not predict

symptomatic outcome at the end of the season. The decrease in Doppler flow during the season might suggest that intratendinous flow could be part of a physiological adaptive response to loading and that intratendinous flow as previously believed is not always a sign of pathological changes.

Knee Surg Sports Traumatol Arthrosc. 2012 Oct;20(10):1891-4. Epub 2012 Aug 14.

J Sport Rehabil. 2012 Feb;21(1):34-43. Epub 2011 Nov 15.

Tendon structure's lack of relation to clinical outcome after eccentric exercises in chronic midportion

Achilles tendinopathy.

de Vos RJ, Heijboer MP, Weinans H, Verhaar J AN, van Schie J TM.

Abstract

CONTEXT:

Chronic midportion Achilles tendinopathy is a common and hard-to-treat disorder characterized by degenerative changes of the tendon matrix. Ultrasonographic tissue characterization (UTC) was successfully used to quantify structural human Achilles tendon changes. This novel and reliable technique could be used in follow-up studies to relate tendon structure to symptoms.

OBJECTIVE:

To quantify structural tendon changes and assess clinical change in patients with tendinopathy.

DESIGN:

Prospective observational study.

SETTING:

Orthopedic department in a university medical center.

PATIENTS:

23 patients with chronic midportion Achilles tendinopathy.

INTERVENTION:

The patients performed a 16-wk home-based eccentric exercise program. An experienced researcher performed the ultrasonographic data collection with the UTC procedure. These data were assessed by a blinded observer. The severity of symptoms was established with the validated Victorian Institute of Sport Assessment-Achilles (VISA-A) questionnaire.

MAIN OUTCOME MEASURES:

UTC was performed to quantify tendon structure through measuring the proportion of 4 echo types. Echo types I and II represent more or less organized tendon bundles, and echo types III and IV represent disintegrated tendon structure. On the VISA-A, the total possible score is divided by 100 for a percentage score, with a perfect score of 100. Follow-up was at 2, 8, 16, and 24 wk.

RESULTS:

The mean percentage of echo types I and II changed by 0.3% after 24 wk ($P = .92$, 95% CI -5.8 to 5.3). The mean VISA-A score increased slightly but significantly by 11.3 points after 24 wk ($P = .01$, 95% CI 2.6-20.0). An increased VISA-A score was not correlated with an increased percentage of echo types I and II ($P = .94$, $r = -.02$), and the baseline percentage of echo types I and II did not correlate with an increased VISA-A score ($P = .74$, $r = .07$).

CONCLUSIONS:

There is no short-term increase in organized tendon structure after eccentric exercises. Tendon structure is not related to symptom severity and cannot be used as a predictor of clinical outcome.

Neovascularization in Achilles tendinopathy: have we been chasing a red herring?

Tol JL, Spiezia F, Maffulli N.

Abstract

The concept of neovascularization in tendinopathy seems to have gained nearly mythological proportions and quasi-religious state: it is considered of diagnostic and prognostic value, related to clinical outcome, and the exclusive target of some therapeutic interventions. However, we question whether these assumptions are based on scientific evidence, and we come to the conclusion that, in the light of recent well-performed research, it seems that detecting neovessels has no additional value for the diagnosis, no firmly confirmed prognostic value, and no proven relation with symptoms. The role of neovascularization in this field should be re-thought. Level of evidence V.

MANAGEMENT

Sports Med. 2012 Nov 1;42(11):941-67. doi: 10.2165/11635410-00000000-00000.

Conservative management of midportion achilles tendinopathy: a mixed methods study, integrating systematic review and clinical reasoning.

Rowe V, Hemmings S, Barton C, Malliaras P, Maffulli N, Morrissey D.

Abstract

Background: Clinicians manage midportion Achilles tendinopathy (AT) using complex clinical reasoning underpinned by a rapidly developing evidence base. **Objectives:** The objectives of the study were to develop an inclusive, accessible review of the literature in combination with an account of expert therapists' related clinical reasoning to guide clinical practice and future research. **Methods:** Searches of the electronic databases, PubMed, ISI Web of Science, PEDro, CINAHL, EMBASE, and Google Scholar were conducted for all papers published from inception to November 2011. Reference lists and citing articles were searched for further relevant articles. Inclusion required studies to evaluate the effectiveness of any conservative intervention for midportion AT. Exclusion criteria included in vitro, animal and cadaver studies and tendinopathies in other locations (e.g. patella, supraspinatus). From a total of 3497 identified in the initial search, 47 studies fulfilled the inclusion criteria. Studies were scored according to the PEDro scale, with a score of ≥8/10 considered of excellent quality, 5-7/10 good, and ≤4/10 poor. The strength of evidence supporting each treatment modality was then rated as 'strong', 'moderate', 'limited', 'conflicting' or 'no evidence' according to the number and quality of articles supporting that modality. Additionally, semi-structured interviews were conducted with physiotherapists to explore clinical reasoning related to the use of various interventions with and without an evidence base, and their perceptions of available evidence. **Results:** Evidence was strong for eccentric loading exercises and extracorporeal shockwave therapy; moderate for splinting/bracing, active rest, low-level laser therapy and concentric exercises (i.e. inferior to eccentric exercise). In-shoe foot orthoses and therapeutic ultrasound had limited evidence. There was conflicting evidence for topical glycerin trinitrate. Taping techniques and soft-tissue mobilization were not yet examined but featured in case studies and in the interview data. Framework analysis of interview transcripts yielded multiple themes relating to physiotherapists' clinical reasoning and perceptions of the evidence, including the difficulty in causing pain while treating the condition and the need to vary research protocols for specific client groups - such as those with the metabolic syndrome as a likely etiological factor. Physiotherapists were commonly applying the modality with the strongest evidence base, eccentric loading exercises. Barriers to research being translated into practice identified included the lack of consistency of outcome measures, excessive stringency of some authoritative reviews and difficulty in accessing primary research reports. The broad inclusion criteria meant some lower quality studies were included in this review. However, this was deliberate to ensure that all available research evidence for the management of midportion AT, and all studies were evaluated using the PEDro scale to compensate for the lack of stringent inclusion criteria. **Conclusion:** Graded evidence combined with qualitative analysis of clinical reasoning produced a novel and clinically applicable guide to conservative management of midportion AT. This guide will be useful to novice clinicians learning how to manage this treatment-resistant condition and to expert clinicians reviewing their evidence-based practice and developing their clinical reasoning. Important areas requiring future research were identified including the effectiveness of orthoses, the effectiveness of manual therapy, etiological factors, optimal application of loading related to stage of presentation and how to optimize protocols for different types of patients such as the older patient with the metabolic syndrome as opposed to the athletically active.

Knee Surg Sports Traumatol Arthrosc. 2012 Aug;20(8):1632-46. Epub 2011 Dec 21.

Treatment of patellar tendinopathy-a systematic review of randomized controlled trials.

Larsson ME, Käll I, Nilsson-Helander K.

Abstract

PURPOSE:

Patellar tendinopathy is a common, painful, overuse disorder. Although many different treatment methods have been described, there is no consensus regarding the optimal treatment for this condition. The purpose of this study was to systematically review, summarize, and compare treatments for patellar tendinopathy from published randomized controlled trials.

METHODS:

Database searches were performed for randomized prospective controlled trials comparing treatment methods for patellar tendinopathy. The thirteen articles considered relevant were scrutinized according to quality assessment guidelines and levels of evidence.

RESULTS:

Strong evidence was found for the use of eccentric training to treat patellar tendinopathy. Moderate evidence was found for conservative treatment (heavy slow resistance training) as an alternative to eccentric training. Moderate evidence suggests that low-intensity pulsed ultrasound treatment did not influence treatment outcomes. Limited evidence was found for surgery, sclerosing injections, and shockwave therapy.

CONCLUSION:

Physical training, and particularly eccentric training, appears to be the treatment of choice for patients suffering from patellar tendinopathy. However, type of exercise, frequency, load, and dosage must also be analyzed. Other treatment methods, such as surgical treatment, sclerosing injections, and shockwave therapy, must be investigated further before recommendations can be made regarding their use. Ultrasound can likely be excluded as a treatment for patellar tendinopathy. There is a persistent lack of well-designed studies with sufficiently long-term follow-up and number of patients to draw strong conclusions regarding therapy.

Foot Ankle Int. 2010 Aug;31(8):689-94.

Insertional achilles tendinopathy management: a systematic review.

Kearney R, Costa ML.

Abstract**BACKGROUND:**

Achilles tendinopathy is a common problem and its management remains controversial. However, many clinicians consider that the sub-group of patients with insertional Achilles tendinopathy are even more difficult to manage. The aim of this systematic review was to review evidence for interventions specific to insertional Achilles tendinopathy.

MATERIALS & METHODS:

Medline and the Cochrane library were searched using a pre-defined search strategy. All study designs were included except case studies, narrative reviews, technical notes and letters/personal opinion. The results were evaluated independently by two reviewers and assessed against the inclusion/exclusion criteria. All included articles were assessed for methodological quality and study characteristics were extracted into a table.

RESULTS:

One hundred eighteen articles were identified through the search strategy, of which 11 met the eligibility criteria. Six studies evaluated operative techniques following failed conservative management and five evaluated conservative interventions only. The overall level of evidence was limited to case series evaluations and one randomized controlled trial.

CONCLUSION:

There is a consensus that conservative methods should be used before operative interventions. Current evidence for conservative treatment favors eccentric loading and shock wave therapy, although there is limited evidence by which to judge their effectiveness. Evaluation of operative interventions has been mostly retrospective and remains inconclusive.

Sports Health. 2012 Sep;4(5):384-93.

Evaluation and management of elbow tendinopathy.

Taylor SA, Hannafin JA.

Abstract**CONTEXT:**

Elbow tendinopathy is a common cause of pain and disability among patients presenting to orthopaedic surgeons, primary care physicians, physical therapists, and athletic trainers. Prompt and accurate diagnosis of these conditions facilitates a directed treatment regimen. A thorough understanding of the natural history of these injuries and treatment outcomes will enable the appropriate management of patients and their expectations. EVIDENCE ACQUISITIONS: The PubMed database was searched in December 2011 for English-language articles pertaining to elbow tendinopathy.

RESULTS:

Epidemiologic data as well as multiple subjective and objective outcome measures were investigated to elucidate the incidence of medial epicondylitis, lateral epicondylitis, distal biceps and triceps ruptures, and the efficacy of various treatments.

CONCLUSIONS:

Medial and lateral epicondylitis are overuse injuries that respond well to nonoperative management. Their etiology is degenerative and related to repetitive overuse and underlying tendinopathy. Nonsteroidal anti-inflammatory drugs and localized corticosteroid injections yield moderate symptomatic relief in short term but

do not demonstrate benefit on long-term follow-up. Platelet-rich plasma injections may be advantageous in cases of chronic lateral epicondylitis. If 6 to 12 months of nonoperative treatment fails, then surgical intervention can be undertaken. Distal biceps and triceps tendon ruptures, in contrast, have an acute traumatic etiology that may be superimposed on underlying tendinopathy. Prompt diagnosis and treatment improve outcomes. While partial ruptures confirmed with magnetic resonance imaging can be treated nonoperatively with immobilization, complete ruptures should be addressed with primary repair within 3 to 4 weeks of injury.

REHABILITATION & LOADING

Clin Rehabil. 2012 May;26(5):423-30. Epub 2011 Aug 19.

Comparing the effects of eccentric training with eccentric training and static stretching exercises in the treatment of patellar tendinopathy. A controlled clinical trial.

Dimitrios S, Pantelis M, Kalliopi S.

Abstract

OBJECTIVE:

The aim of the present study was to investigate the effectiveness of eccentric training and eccentric training with static stretching exercises in the management of patellar tendinopathy.

DESIGN:

Controlled clinical trial.

SETTING:

Rheumatology and rehabilitation centre.

SUBJECTS:

Forty-three patients who had patellar tendinopathy for at least three months. They were allocated to two groups by alternative allocation.

INTERVENTIONS:

Group A (n = 22) was treated with eccentric training of patellar tendon and static stretching exercises of quadriceps and hamstrings and Group B (n = 21) received eccentric training of patellar tendon. All patients received five treatments per week for four weeks.

OUTCOMES:

Pain and function were evaluated using the VISA-P score at baseline, at the end of treatment (week 4), and six months (week 24) after the end of treatment.

RESULTS:

At the end of treatment, there was a rise in VISA-P score in both groups compared with baseline ($P<0.0005$, paired t test). There were significant differences in the VISA-P score between the groups at the end of treatment (+14; 10 to 18) and at the six-month follow-up (+19; 13 to 24); eccentric training and static stretching exercises produced the largest effect ($P<0.0005$, one-way ANOVA).

CONCLUSIONS:

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.

Br J Sports Med. 2012 Mar;46(3):214-8. Epub 2011 Nov 10.

A 5-year follow-up study of Alfredson's heel-drop exercise programme in chronic midportion Achilles tendinopathy.

van der Plas A, de Jonge S, de Vos RJ, van der Heide HJ, Verhaar JA, Weir A, Tol JL.

Abstract

BACKGROUND:

Eccentric exercises have the most evidence in conservative treatment of midportion Achilles tendinopathy. Although short-term studies show significant improvement, little is known of the long-term (>3 years) results.

AIM:

To evaluate the 5-year outcome of patients with chronic midportion Achilles tendinopathy treated with the classical Alfredson's heel-drop exercise programme.

STUDY DESIGN:

Part of a 5-year follow-up of a previously conducted randomised controlled trial. Methods 58 patients (70 tendons) were approached 5 years after the start of the heel-drop exercise programme according to Alfredson. At baseline and at 5-year follow-up, the validated Victorian Institute of Sports Assessment-Achilles (VISA-A)

questionnaire score, pain status, alternative treatments received and ultrasonographic neovascularisation score were recorded.

RESULTS:

In 46 patients (58 tendons), the VISA-A score significantly increased from 49.2 at baseline to 83.6 after 5 years ($p<0.001$) and from the 1-year to 5-year follow-up from 75.0 to 83.4 ($p<0.01$). 39.7% of the patients were completely pain-free at follow-up and 48.3% had received one or more alternative treatments. The sagittal tendon thickness decreased from 8.05 mm (SD 2.1) at baseline to 7.50 mm (SD 1.6) at the 5-year follow-up ($p=0.051$).

CONCLUSION:

At 5-year follow-up, a significant increase of VISA-A score can be expected. After the 3-month Alfredson's heel-drop exercise programme, almost half of the patients had received other therapies. Although improvement of symptoms can be expected at long term, mild pain may remain.

Scand J Med Sci Sports. 2012 Jun 21. doi: 10.1111/j.1600-0838.2012.01497.x. [Epub ahead of print]

Ability to perform a single heel-rise is significantly related to patient-reported outcome after Achilles tendon rupture.

Olsson N, Karlsson J, Eriksson BJ, Brorsson A, Lundberg M, Silbernagel KG.

Abstract

This study evaluated the short-term recovery of function after an acute Achilles tendon rupture, measured by a single-legged heel-rise test, with main emphasis on the relation to the patient-reported outcomes and fear of physical activity and movement (kinesiophobia). Eighty-one patients treated surgically or non-surgically with early active rehabilitation after Achilles tendon rupture were included in the study. Patient's ability to perform a single-legged heel-rise, physical activity level, patient-reported symptoms, general health, and kinesiophobia was evaluated 12 weeks after the injury. The heel-rise test showed that 40 out of 81 (49%) patients were unable to perform a single heel-rise 12 weeks after the injury. We found that patients who were able to perform a heel-rise were significantly younger, more often of male gender, reported a lesser degree of symptoms, and also had a higher degree of physical activity at 12 weeks. There was also a significant negative correlation between kinesiophobia and all the patient-reported outcomes and the physical activity level. The heel-rise ability appears to be an important early achievement and reflects the general level of healing, which influences patient-reported outcome and physical activity. Future treatment protocols focusing on regaining strength early after the injury therefore seem to be of great importance. Kinesiophobia needs to be addressed early during the rehabilitation process.

Phys Ther Sport. 2012 Sep 22. pii: S1466-853X(12)00053-3. doi: 10.1016/j.ptsp.2012.05.002.

An exercise-based physical therapy program for patients with patellar tendinopathy after platelet-rich plasma injection.

van Ark M, van den Akker-Scheek I, Meijer LT, Zwerver J.

Abstract

OBJECTIVES:

To describe a post platelet-rich plasma (PRP) injection, exercise-based physical therapy program, investigate feasibility and report the first results of patellar tendinopathy patients treated with PRP injection combined with the physical therapy program.

STUDY DESIGN:

Case-series.

SETTING:

A PRP injection followed by a physical therapy program seems promising for the treatment of patellar tendinopathy. However, descriptions of physical therapy programs are often limited and incomplete.

PARTICIPANTS:

Five patellar tendinopathy patients (six tendons) in the degenerative phase.

MAIN OUTCOME MEASURE:

VISA-P score.

RESULTS:

Muscle strength, endurance, power and retraining sport-specific function form the basis for the physical therapy program aiming to improve the load capacity of the knee. The program is characterised by gradually increasing intensity and difficulty of exercises. Five of the six tendons showed an improvement of at least 30 points on the VISA-P after 26 weeks.

CONCLUSIONS:

This study extensively describes, based on current knowledge, a physical therapy program after PRP injection for patellar tendinopathy patients. The combination treatment reported in this study is feasible and seems to be promising for patients in the late/degenerative phase of patellar tendinopathy.

PHYSICAL THERAPIES

J Foot Ankle Res. 2012 Jul 2;5(1):15. [Epub ahead of print]

Physical therapies for Achilles tendinopathy: systematic review and meta-analysis.

Sussmilch-Leitch SP, Collins NJ, Bialocerkowski AE, Warden SJ, Crossley KM.

Abstract

ABSTRACT: Achilles tendinopathy (AT) is a common condition, causing considerable morbidity in athletes and non-athletes alike. Conservative or physical therapies are accepted as the first line approach for management of AT. Despite a growing volume of research in AT, there remains a lack of high quality studies evaluating their efficacy. Previous systematic reviews provide preliminary evidence for non-surgical interventions for AT, but lack key quality components as outlined in the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Statement. This study aims to conduct a systematic review and meta-analysis (where possible) of the evidence for physical therapies for AT management. A comprehensive strategy was used to search 11 electronic databases from inception to September 13th 2011. Search terms included Achilles, tendinopathy, pain, physical therapies, electrotherapy and exercise (English language full-text publications, human studies). Reference lists of eligible papers were hand-searched. Randomised controlled trials (RCTs) were included if they evaluated at least one non-pharmacological, non-surgical intervention for AT using at least one outcome of pain and/or function. Two independent reviewers screened 2852 search results, identifying 23 suitable studies. Two independent reviewers assessed methodological quality and risk of bias using a modified PEDro scale. One reviewer extracted study characteristics and data for effect size calculations. Methodological quality ranged from 2 to 12 (/14). Four studies were excluded due to high risk of bias, leaving 19 studies. Evidence from meta-analyses supports the use of shock wave therapy (SWT) for outcomes of pain and function (standardised mean difference -0.46, 95% confidence interval -0.88 to -0.04) and pain (-0.50, -0.90 to -0.10) at 16 weeks, and laser therapy (LT) with eccentric exercise at 12 weeks (-0.51, -0.95 to -0.06), but did not support the addition of night splints to eccentric exercise. Effect sizes from individual studies support the use of eccentric exercise, while limited evidence suggests microcurrent therapy to be an effective intervention. Practitioners should consider SWT and LT as initial interventions for AT, in conjunction with eccentric exercise. Further high-quality RCTs following CONSORT guidelines are required to establish the efficacy of other physical therapies and determine optimal clinical pathways for AT.

Acupunct Med. 2012 Aug 23. [Epub ahead of print]

Is there a role for acupuncture in the treatment of tendinopathy?

Neal BS, Longbottom J.

Abstract

Tendinopathy is a debilitating condition in athletic and sedentary populations for which a gold standard treatment strategy does not yet exist. While the pathophysiology of tendinopathy is well understood, a debate remains as to the nature of the pain mechanism in tendinopathy which makes treatment selection challenging. This clinical discussion presents evidence to suggest that acupuncture may have a role in the treatment of tendinopathy, through the facilitation of tendon blood flow and fibroblastic activity, making recommendations for further research.

MEDICINES AND INJECTIONS

Br J Sports Med. 2012 Aug 28. [Epub ahead of print]

Topical glyceryl trinitrate treatment of chronic patellar tendinopathy: a randomised, double-blind, placebo-controlled clinical trial.

Steunebrink M, Zwerver J, Brandsema R, Groenenboom P, Akker-Scheek IV, Weir A.

Abstract

OBJECTIVES:

To assess if continuous topical glyceryl trinitrate (GTN) treatment improves outcome in patients with chronic patellartendinopathy when compared with eccentric training alone.

METHODS:

Randomised double-blind, placebo-controlled clinical trial comparing a 12-week programme of using a GTN or placebo patch in combination with eccentric squats on a decline board. Measurements were performed at baseline, 6, 12 and 24 weeks. Primary outcome measure was the Victorian Institute of Sports Assessment-Patella (VISA-P) questionnaire. Secondary outcome measures were patient satisfaction and pain scores during sports. Generalised estimated equation was used to analyse the treatment, time and treatment \times time effect. Analyses were performed following the intention-to-treat principle.

RESULTS:

VISA-P scores for both groups improved over the study period to 75.0 ± 16.2 and 80.7 ± 22.1 at 24 weeks. Results showed a significant effect for time ($p < 0.01$) but no effect for treatment \times time ($p = 0.80$). Mean Visual Analogue Scores pain scores during sports for both groups increased over the study period to 6.6 ± 3 and 7.8 ± 3.1 . Results showed a significant effect for time ($p < 0.01$) but no effect for treatment \times time ($p = 0.38$). Patient satisfaction showed no difference between GTN and placebo groups ($p = 0.25$) after 24 weeks, but did show a significant difference over time ($p = 0.01$). Three patients in the GTN group reported some rash.

CONCLUSION:

It seems that continuous topical GTN treatment in addition to an eccentric exercise programme does not improve clinical outcome compared to placebo patches and an eccentric exercise programme in patients with chronic patellar tendinopathy.

Int Orthop. 2012 Sep;36(9):1941-6. Epub 2012 Apr 27.

Pain and activity levels before and after platelet-rich plasma injection treatment of patellar tendinopathy: a prospective cohort study and the influence of previous treatments.

Gosens T, Den Oudsten BL, Fievez E, van 't Spijker P, Fievez A.

Abstract**PURPOSE:**

The aim of this study was to evaluate the outcome of patients with patellar tendinopathy treated with platelet-rich plasma injections (PRP). Additionally, this study examined whether certain characteristics, such as activity level or previous treatment affected the results.

METHODS:

Patients ($n = 36$) were asked to fill in the Victorian Institute of Sports Assessment - Patellar questionnaire (VISA-P) and visual analogue scales (VAS), assessing pain in activities of daily life (ADL), during work and sports, before and after treatment with PRP. Of these patients, 14 had been treated before with cortisone, ethoxysclerol, and/or surgical treatment (group 1), while the remaining patients had not been treated before (group 2).

RESULTS:

Overall, group 1 and group 2 improved significantly on the VAS scales ($p < .05$). However, group 2 also improved on VISA-P ($p = .003$), while group 1 showed less healing potential ($p = 0.060$). Although the difference between group 1 and group 2 at follow-up was not considered clinically meaningful, over time both groups showed a clinically significant improvement.

CONCLUSION:

After PRP treatment, patients with patellar tendinopathy showed a statistically significant improvement. In addition, these improvements can also be considered clinically meaningful. However, patients who were not treated before with ethoxysclerol, cortisone, and/or surgical treatment showed the improvement.

Journal of Ultrasound (2012)xx,1e7

Ultrasound-guided injection of platelet-rich plasma in chronic Achilles and patellar tendinopathy

G. Ferrero, E. Fabbr, D. Orlandi, C. Martini, F. Lacelli, G. Serafini, E. Silvestri, L.M. Sconfienza

Abstract

Purpose: The efficacy of platelet-rich plasma (PRP) in the treatment and healing of chronic tendinopathy through stimulation of cell proliferation and total collagen production has been demonstrated by both in vitro and in vivo studies. The aim of this study is to evaluate the effectiveness of ultrasound (US)-guided autologous PRP injections in patellar and Achilles tendinopathy.

Materials and methods: Autologous PRP was injected under US-guidance into the Achilles and

patellar tendons (30 Achilles tendons, 28 patellar tendons) in 48 prospectively selected patients (30 males, 18 females, mean age 38–16 years, range 20–61 years). All patients were previously evaluated according to the Victoria Institute of Sport Assessment (VISA) scale, which assessed pain and activity level, and they all underwent US of the tendon before treatment and at follow-up after 20 days and 6 months. Statistical analysis was performed with Chi-square and Wilcoxon tests.

Results: 20 days after PRP injection the patients presented a non-significant improvement of clinical symptoms. At the 6-month follow-up VISA score increased from a mean value of 57 ± 7.5 ($p < .01$). US evaluation revealed a reduction of hypoechoic areas in 26 tendons ($p < .01$) associated with a widespread improvement of fibrillar echotexture of the tendon and reduced hypervascularity at power Doppler.

Conclusion: PRP injection in patellar and Achilles tendinopathy results in a significant and lasting improvement of clinical symptoms and leads to recovery of the tendon matrix potentially helping to prevent degenerative lesions. US-guidance allows PRP injection into the tendon with great accuracy.

J Foot Ankle Surg. 2012 Jul 21. [Epub ahead of print]

A Prospective Series of Patients with Chronic Achilles Tendinopathy Treated with Autologous-conditioned Plasma Injections Combined with Exercise and Therapeutic Ultrasonography.

Deans VM, Miller A, Ramos J.

Abstract

Chronic Achilles tendinopathy is a difficult problem to manage, because it can result in significant patient morbidity. We conducted a prospective case series involving 26 patients (2 bilateral cases) with painful and ultrasound-confirmed Achilles tendinopathy for a minimum duration of 6 months. Our objective was to assess whether this condition can be effectively treated with a treatment protocol combining an intratendinous autologous-conditioned plasma injection followed by a standardized rehabilitation protocol. The rehabilitation protocol consisted of full weightbearing in a pneumatic cast boot for 6 weeks, therapeutic ultrasound treatment, and an eccentric exercise program. Our results showed statistically significant improvements in terms of pain ($p < .0001$), other symptoms ($p = .0003$), activities of daily living ($p = .0002$), sports activities ($p = .0001$), and quality of life ($p = .0002$). We believe that the use of autologous-conditioned plasma can provide a potential treatment solution for chronic Achilles tendinopathy

Am J Sports Med. 2012 Mar;40(3):542-7. Epub 2012 Jan 11.

Ultrasound-guided sclerosis of neovessels in patellar tendinopathy: a prospective study of 101 patients.

Hoksrud A, Torgalsen T, Harstad H, Haugen S, Andersen TE, Risberg MA, Bahr R.

Abstract

BACKGROUND:

A randomized controlled study has shown promising clinical results after treatment with sclerosing injections in a group of patients with patellar tendinopathy, but no study has investigated medium- or long-term outcome in a large and unselected group of patients.

PURPOSE:

To investigate if sclerosing treatment would affect the level of patellar tendon pain and knee function after 24 months in a large group of patients with patellar tendinopathy.

STUDY DESIGN:

Case series; Level of evidence, 4.

METHODS:

This prospective study recruited patients with a clinical diagnosis of jumper's knee and visible neovascularization corresponding to the painful area on power Doppler ultrasound. They received up to a maximum of 5 ultrasound-guided sclerosing injections using polidocanol at 4- to 6-week intervals. Knee pain and function were recorded using the Victorian Institute of Sport Assessment-Patella (VISA-P) score before treatment and 6, 12, and 24 months after the first injection.

RESULTS:

In total, 101 patients (15 women and 86 men) with 120 tendons were included and given from 1 to 5 sclerosing injections (mean [SD], 2.5 [0.9]). The patients reported a significantly improved VISA-P score from baseline (mean, 39; 95% confidence interval [CI], 36–42) to the 24-month follow-up (mean, 65; 95% CI, 60–70) (range, 21–100; $P < .001$, paired t test). However, a VISA-P score of >95 points was reported in only 22 cases (20%), whereas 37 cases (36%) reported a VISA-P score of <50 at 24 months.

CONCLUSION:

Sclerosing treatment with polidocanol resulted in a moderate improvement in knee function and reduced pain in a heterogeneous group of patients with patellar tendinopathy. Nevertheless, few of the patients were cured, and the majority still had reduced function and substantial pain after 24 months of follow-up.