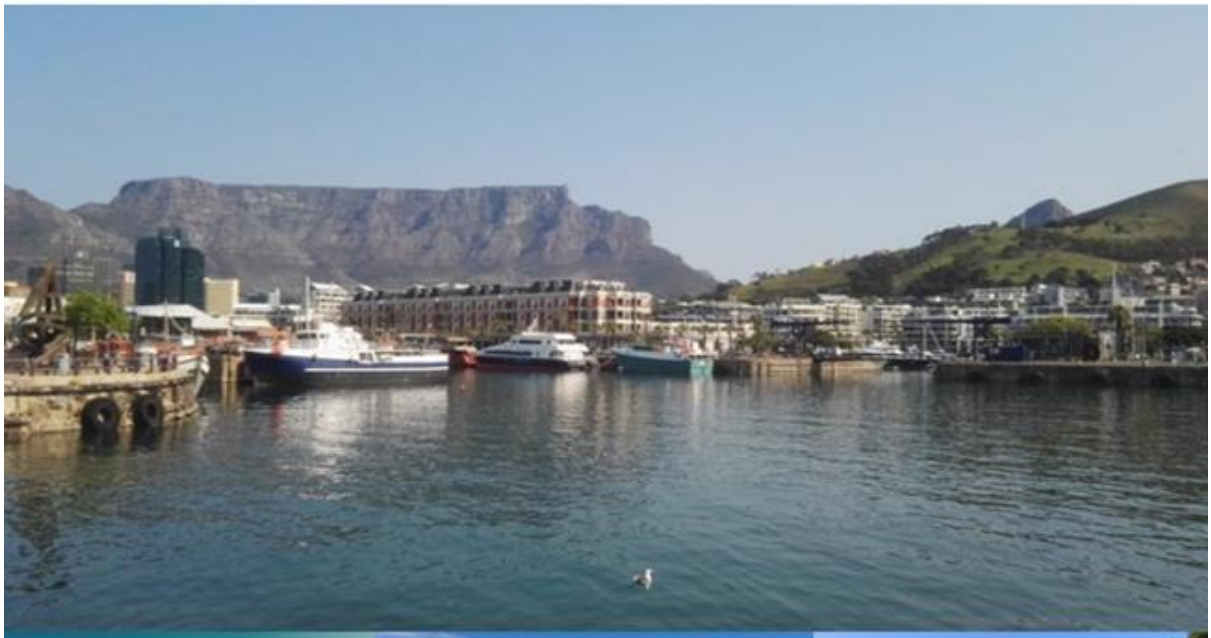
TODAY'S RESEARCH ... TOMORROW'S TRANSLATION

4TH INTERNATIONAL SCIENTIFIC TENDINOPATHY SYMPOSIUM

Cape Town, South Africa 22-24 October 2016



Hosted by

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

essm
EXERCISE SCIENCE AND SPORTS MEDICINE

Sponsors

utcimaging

inqaba biotec™

GESTIG 1685 FOUNDED
GROOT CONSTANTIA
LANDGOED • ESTATE

SASMA
SOUTH AFRICAN SPORTS MEDICINE ASSOCIATION

British Journal of
Sports Medicine

Contents

P1: The Effect of Load on Achilles Tendon Structure in Novice Runners

LM Rabello[1]; OW Heyward[2]; L van der Woude[2]; I Van den Akker-Scheek; H van der Worp[1]; and J Zwerver[1]

[1]Department of Sports Medicine, University of Groningen, Groningen, University Medical Center Groningen, , The Netherlands, [2]Centre for Human Movement Sciences, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands, Groningen, The Netherlands

***Presenting Author E-mail address**: l.maciel.rabello@umcg.nl*

Introduction: Achilles tendinopathy, characterized by pain and dysfunction, with an incidence estimated between 11% and 29% in runners and 6% in sedentary people. The incidence is higher in athletes but sedentary people are also affected by this condition. There is an association between tendinopathy and load in which repetitive and poorly managed load is assumed to be a major factor in developing tendinopathy due to the tendons negative reaction to a stimulus. Different imaging tools are used to assess the effect of load in tendons. Ultrasonographic Tissue Characterization (UTC) can quantify tendon structure into four echotypes based upon echo pattern stability. The aim of this study was to observe the changes in Achilles tendon structure in novice runners, with loading prescriptions of 100% body weight compared to 20% body weight.

Methods: A randomized crossover design was employed. 20 novice runners participated in two separate 20 minutes running bouts spaced 14 days apart, one of high load (HL) at 100% body weight on a normal treadmill, and one of low load (LL) at 20% body weight on an Alter-G antigravity treadmill. UTC was measured on 6 occasions; immediately prior to each run, 2 and 7 days after each run.

Results: No change was seen in any of the four echotype percentages as a result of the LL or HL running bouts. Echotypes III and IV decreased over time, with a significant effect. The interaction effect of time and condition was not found to be significant for echotypes I-IV [Wald chi-square = 2.8, d.f. = 2,P = 0.247; Wald chi-square = 2.888, d.f. = 2,P = 0.236; Wald chi-square = 1.385, d.f. = 2,P = 0.5; Wald chi-square = 4.19, d.f. = 2,P = 0.123], respectively.

Discussion: The results of this study show that there were no load dependent changes in echotype percentages of novice runners after one moderate or low load running bout. The decrease in echotypes III and IV suggest that moderate loads can be applied to the Achilles tendon without compromising tendon structure. Low to moderate loads may be beneficial in the management of Achilles tendinopathy.

P2: Investigating the role of *ELN* rs2071307 gene variant as a risk factor for Achilles Tendon Pathologies in a British Cohort.

LY El Khoury[1,2], WJ Ribbans[1], SM Raleigh[1]

[1]The Centre for Physical Activity and Chronic Disease, The Institute of Health and Wellbeing, University of Northampton, UK; [2]School of Biological Sciences, University of Essex, UK

***Presenting author e-mail address**: Louis.el-khoury@essex.ac.uk*

Introduction: The harmonious interaction of elastin and other structural proteins allows tendons to respond to tensile load by stretching and returning to their original lengths. Achilles tendinopathies and rupture, jointly referred to as Achilles tendon pathologies (ATPs), are polygenic phenotypes with poorly defined aetiologies resulting from either chronic or acute exposure to repetitive and strenuous physical activities. The *ELN* rs2071307 variant has been associated with soft tissue pathologies such as aortic stenosis[1] and aneurysms[2]. The substitution of the hydrophobic amino acid glycine with the hydrophilic serine renders this non-synonymous G/A SNP a good candidate variant to investigate. However, in a previous study this variant was not associated with either Achilles tendinopathy or ACL

rupture in populations from Australia and South Africa[3]. As recent evidence suggests that genetic risk factors for tendinopathy may depend, to some extent, on geographic location[4], the aim of this study was to determine whether the *ELN* rs2071307 variant was associated with the risk of ATP in a British cohort.

Methods: A British Caucasian cohort consisting of 108 ATP cases (TEN n=84 and RUP n=24) and 131 asymptomatic controls were recruited for this case-control genetic association study. All participants were genotyped using TaqMan technology for the *ELN* G/A rs2071307. Population data such as genotype and allele frequencies in addition to the Hardy-Weinberg Equilibrium were calculated using the R Genetics package. Statistical significance was accepted at $p<0.05$.

Results: There was no significant genotypic or allelic association between the *ELN* rs2071307 and the risk of TEN (p=0.086, p=0.119), RUP (p=0.501, p=0.243), or when both pathologies were combined into the ATP group (p=0.413, p=0.399) respectively.

Discussion: Although the association of the *ELN* rs2071307 gene variant with soft tissue pathologies is documented in aortic stenosis and aneurysms, it appears not to be associated with the risk of ATPs in a British Caucasian cohort. This data is consistent with the early study in Australian and South African cohorts. It should be noted however, that the sample number is small and that these findings require replication in other ethnicities.

References:

1. Ellis SG, Dushman-Ellis S, Luke MM, *et al.* Pilot candidate gene analysis of patients ≥ 60 years old with aortic stenosis involving a tricuspid aortic valve. *Am J Cardiol* 2012;**110**:88–92.
2. Saracini C, Bolli P, Sticchi E, *et al.* Polymorphisms of genes involved in extracellular matrix remodeling and abdominal aortic aneurysm. *J Vasc Surg* 2012;**55**:171–9.e2.
3. El Khoury L, Posthumus M, Collins M, *et al.* ELN and FBN2 gene variants as risk factors for two sports-related musculoskeletal injuries. *Int J Sports Med* 2015;**36**:333–7.
4. El Khoury L, Ribbans WJ, Raleigh SM. MMP3 and TIMP2 gene variants as predisposing factors for Achilles tendon pathologies: Attempted replication study in a British case–control cohort. *Meta Gene* 2016;**9**:52–5.

P3: The effect of substance P and acetylcholine on tenocyte proliferation converge mechanistically via TGF-β1

G Fong * [1,2]; *L J Backman* * [1]; *P Danielson* [1]
**Co-First Author*
[1] *Department of Integrative Medical Biology, Anatomy, Umeå University, Umeå, Sweden*
[2] *Centre for Hip Health and Mobility, Vancouver Coastal Health and Research Institute, British Columbia, Canada*
Presenting Author E-mail address: *gloria.fong@umu.se*

Introduction: Previous *in-vitro* studies on tenocytes have demonstrated that exogenous administration of substance P (SP) and acetylcholine (ACh) independently result in proliferation which is a prominent feature of tendinosis. Interestingly, the link between SP and ACh have not yet been explored. Studies demonstrate that both SP and ACh independently upregulate TGF-β1 expression via their respective receptors, neurokinin 1 receptor (NK-1R) and muscarinic ACh receptors (mAChRs).[1,2] Furthermore, TGF-β1 has been shown to downregulate NK-1R expression.[3] Consequently, it can be hypothesized that TGF-β1 is the intermediary player involved in mediating the pathways shared by SP and ACh in human tenocytes. In the present study, we examined if the known proliferative effects of SP and ACh converged via TGF-β1.

Methods: Human Achilles tendon cells (tenocytes) were cultured and exposed to exogenous SP, ACh, and TGF-β1, along with their respective receptor blockers. The mRNA and protein levels for NK-1R, mAChRs, and TGF-β1 were measured using RT-qPCR, Western Blot, and ELISA. Proliferation was measured using MTS and crystal violet assays.

Results: Exogenous administration of SP and ACh both resulted in upregulation of TGF-β1 at the mRNA and protein level. In addition, exogenous TGF-β1 downregulated both NK-1R and mAChRs expression at the mRNA and protein level. Furthermore, this effect was negated by the TGFβRI/II kinase inhibitor. Finally, exogenous administration of TGF-β1 resulted in increased cell viability, which was effectively blocked in the presence of TGFβRI/II kinase inhibitor.

Discussion: Based on the results, we propose that TGF-β1 is the intermediary player through which the actions of both SP and ACh converge mechanistically. In this study, the exposure of tenocytes to SP and ACh resulted in upregulation of TGF-β1. TGF-β1, in turn, decreased the expression of NK-1R and mAChRs, suggesting a negative feedback loop. In tendinosis, it is plausible that this feedback mechanism becomes aberrant, thus resulting in a persistently high expression of TGF-β1, a potent activator of tenocyte proliferation, that leads to hypercellularity in the tendon tissue, a cardinal feature of tendinosis.

References:
1. Yang et al 2014
2. Jin et al 2015
3. Le Roux et al 2015

P4: Tendinosis-like changes in denervated rat Achilles tendon

Roine El-Habta[1]; Ludvig J. Backman[1]
[1]Department of Integrative Medical Biology, Umeå University, Umeå, Sweden
***Presenting Author E-mail address**: roine.el-habta@umu.se*

Introduction: Tendinosis is characterized by several histopathological changes such as hypercellularity, inadequate repair (i.e. disrupted collagen synthesis), and angiogenesis. Previous studies have linked these changes to increased levels of neuropeptide Substance P (SP), and its preferred receptor Neurokinin-1 (NK-1R). When it comes to the histopathological changes and the possible involvement of SP and NK-1R in denervated tendons, little is known. In this study we examined denervated rat Achilles tendons two weeks after peripheral nerve injury.

Methods: Rats that had been denervated for two weeks were sacrificed and the Achilles tendons were collected. Tendons were divided into two pieces, one for immunohistochemical staining, and one for homogenization and extraction of mRNA. Tendons were sectioned using a microtome and immunostained for NK-1R as well as hematoxylin and eosin for morphological examination and cell counting. For qPCR we used hydrolysis probes to detect the expression of TAC1, TACR1, collagen I, and collagen III.

Results: Preliminary results show that denervated tendons contain more and presumably larger cells as compared to the control (contra-lateral leg) ($p<0.05$). No obvious architectural disturbances in the collagen arrangement could be observed but qPCR results revealed highly altered collagen III and collagen I mRNA levels ($p<0.01$, and $p<0.001$, respectively). Immunohistochemical staining indicated increased expression of NK-1R, and the mRNA expression of TACR1 and TAC1 was significantly up-regulated as compared to the control ($p<0.05$, and $p<0.01$, respectively).

Discussion: In this study we confirmed that denervated tendons share many common features with tendinosis, such as hypercellularity, increased levels of SP and NK-1R, as well as disrupted collagen synthesis. Our data stress; (1) that a denervated tendon should be treated as tendinosis once the muscle is re-innervated; (2) that modulation of neuropeptides might preserve a denervated tendon.

P5: Glutamate signaling through the NMDA receptor reduces the tenocyte phenotype in plantaris tendon cells *in vitro* and is modulated by loading and glucocorticoids

C Spang[1]; L Backman[1]; J Chen[1]; Le Roux S[1]; and P Danielson[1]
[1]Department of Integrative Medical Biology, Anatomy Section, Umeå University, Sweden
***Presenting Author E-mail address**: ludvig.backman@umu.se*

Introduction: It has been speculated that signalling substance glutamate may be involved in the process of tendinosis e.g. as an apoptosis inducing substance. In this study, the potential impact of glutamate was further analysed by studying the effect on the tenocyte phenotype. Additionally, the effect of loading and exposure to glucocorticoids on the glutamate signalling machinery was evaluated.

Methods: Tendon specimens used were derived from plantaris tendons. Tendon tissue and cultured primary tendon cells were immunohisto-/cytochemically stained using antibodies against glutamate, NMDA receptor subunit 1 (NMDAR1), the phosphorylated NMDAR1 and vesicular glutamate transporter VGluT2. Tendon cells were further exposed to glutamate or the receptor agonist NMDA for up to 72 hours in concentrations up to 10 mM. The effect on cell death and cell viability was measured via LDH and MTS assays. Western blots were used for detecting c-caspase 3 and c-PARP protein. Scleraxis gene expression (*Scx*) and protein (SCX) were analysed by qPCR and Western blot, respectively. Via a FlexCell system cyclic strain was applied to the cells. The effect of glucocorticoid dexamethasone (Dex) was studies. The mRNA of the glutamate synthesizing enzymes *Got1* and *Gls*, and NMDAR1 protein was measured as a response to cyclic strain and Dex exposure.

Results: Immunoreactions for glutamate, NMDAR1, pNMDAR1 and VGluT2 were detected in tenocytes and peritendinous cells in tissue sections as well as in cultured primary tendon cells. Cell death was induced by a high dose of glutamate (10 mM) but not via exposure of NMDA. Scleraxis mRNA/protein was down-regulated in response to NMDA stimulation. Cyclic strain increased, and dexamethasone decreased, *Gls* and *Got1* gene expression. The amount of NMDAR1 protein expression was increased after 3 days of loading but not affected by dexamethasone exposure.

Discussion: In conclusion, NMDA receptor stimulation leads to a phenotype drift in primary plantaris tendon cells. Furthermore, glutamate synthesis is increased in tendon cells in response to strain. Glucocorticoid stimulation decreased glutamate production. These results imply that locally produced glutamate could be involved in the tissue degeneration observed in tendinosis in response to chronic tendon load.

P6: Glucocorticoids reduce the tenocyte phenotype in primary tendon cells *in vitro* as seen by decreased expression of scleraxis and collagens

C Spang[1]; J Chen[1]; L J Backman[1]
[1]Department of Integrative Medical Biology, Anatomy Section, Umeå University, Sweden
***Presenting Author E-mail address**: ludvig.backman@umu.se*

Introduction: Treating tendinopathies with glucocorticoids has recently been questioned. Several clinical papers have reported higher risks for ruptures and *in vitro* studies have observed glucocorticoid-induced reduction of cell viability and collagen I production in tenocytes. However, little is known about the effect of glucocorticoids on the tendon-specific characteristics of tenocytes. Furthermore, there are uncertainties about the occurence of apoptosis and if the reduction of collagen affects all collagen subtypes similarly.

Methods: To investigate these aspects we cultured primary tendon cells from tissues specimens derived from plantaris tendons. Cells were exposed to glucocorticoid dexamethasone (Dex) in concentrations ranging from 1-1000 nM for up to 5 days. The gene expression of the specific tenocyte

markers scleraxis (*Scx*) and tenomodulin (*Tmnd*) and markers indicating other mesenchymal lineages, such as cartilage (*Acan*, *Col2*, *Sox9*), bone (*Alpl*, *Ocn*), and fat (*Cebpα*, *Pparg*) was analysed via qPCR. Cell proliferation and viability was measured by the use of a MTS Assay. Cell death was detected by LDH Assays and by the presence of cleaved caspase-3 protein using Western Blot. Furthermore, gene expression of collagen subtypes *Col1*, *Col3* and *Col14* was measured.

Results: Dex exposure decreased cell viability (MTS) and LDH levels in a dose-dependent manner. It also induced a significant reduction of Scx gene expression and a marked loss of fibroblast like cell shape. All examined collagen subtypes were found to be down-regulated. Among non-tendinous genes from other mesenchymal lineages *Pparg* was significantly increased, *Acan*, *Alpl* and *Sox9* were significantly decreased.

Discussion: The results of this study suggest that Dex causes a phenotype drift of the tenocytes via decreased scleraxis expression. Reduction of several collagen subtypes but not apoptosis seem to be a characteristics of the use of Dex on tendon tissue. Altogether this study provides further evidence for glucocorticoid induced tendon tissue degeneration.

P7: What tendon pathology is seen on imaging in people who have taken fluoroquinolones? A systematic review

TR Lang[1]; J Cook[2]; E Rio[2]; J Gaida[3] and S Docking[2]
[1]School of Primary Health Care, Monash University, Melbourne, Australia, [2]La Trobe Centre for Sports and Exercise Medicine Research, La Trobe University Melbourne, Australia, [3]University of Canberra Research Institute for Sport and Exercise (UCRISE), Canberra, Australia
***Presenting Author E-mail address**: Jamie.Gaida@canberra.edu.au*

Introduction: Fluoroquinolones (FQs) are highly effective broad spectrum antibiotics. Clinical data reveal an increased incidence of tendon pain and rupture in those taking FQs, yet little is known about tendon structural changes. This review synthesises published data on tendon structural changes in people who have taken FQs.

Methods: Eight databases were searched for potentially relevant articles (Medline, CINAHL, Biological Abstracts, AMED, Web of Knowledge, SCOPUS, SportDiscus and EMBASE) using MeSH and free-text searches. Inclusion and exclusion criteria determined which articles were used for this review.

Results: Twenty-six papers met the eligibility criteria. The Achilles tendon was most commonly affected, while ciprofloxacin and levofloxacin were the most commonly implicated FQs. Mean time to onset of symptoms was sixteen days following first FQ dose. Imaging modalities used included MRI, B-mode ultrasound, and CT. Tendon measurements were rarely reported and intra-tendinous imaging findings were not reported in a consistent manner. Few studies imaged tendons bilaterally and only two studies were longitudinal in design.

Discussion: Future studies should report imaging measures such as thickness and cross-sectional area, and use consistent descriptions of intra-tendinous changes during and post FQ treatment.

P8: The Acute Effects of Mechanical Vibration on Patellar Tendon Elasticity as Assessed by Shear Wave Elastography

Wei-Chen Peng[1], Yi-Ping Chang[2], and Hsing-Kuo Wang[1, 2]

[1]*School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan, R.O.C.,* [2]*Physical Therapy Center, National Taiwan University Hospital, Taipei, Taiwan, R.O.C.*
***E-mail address of presenting Author**: r03428006@ntu.edu.tw*

Introduction: Previous studies showed increased tendon elastic modulus (EM) in patients with patellar tendinopathy. Zhang et al. also found that EM positively correlates with pressure pain and negatively correlates with the patient's Victorian Institute of Sport Assessment-Patella (VISA-P) score. It seems clinically beneficial to reduce the EM in rehabilitation for patellar tendinopathy. The aim of this study was to investigate the effects of mechanical vibrations on the EM by using shear wave elastography (SWE) of the patellar tendon.

Methods: Fifteen healthy adults (median age: 25 years; age range: 22-26 years) were recruited and, for each participant, a mechanical vibration intervention was applied perpendicular to the mid-portion of the right patellar tendon under knee flexion of 90˚ for 10 minutes. SWE, a newly introduced ultrasound-based technique, was used to measure the shear wave velocity (SWV) of the patellar tendon before and immediately after the mechanical vibration, under knee flexions of both 60˚ and 90˚. The Wilcoxon sign ranked test was used for statistical analysis. To evaluate the intra-operator reliability of the measurements of patellar tendon elasticity, seven of the fifteen subjects had their second measurements under both 60˚ and 90˚ of knee flexion taken within 7 days by the same operator.

Results: For knee flexions of both 60˚ and 90˚, the SWV (p= 0.003, 0.004) was significantly decreased after the 10-minute intervention of mechanical vibration. The mean values of SWV for all the 15 participants decreased from 6.34±0.87 (m/s) to 5.39±1.12 (m/s) for the 60˚ flexion, and from 8.80±0.91 (m/s) to 8.00±1.24 (m/s) for the 90˚ flexion. Also, the measurements for both knee flexions had good intra-operator reliability, with an intraclass correlation coefficient (ICC) of 0.902 (95% confidence interval [CI]: 0.428-0.983) and 0.860 (95% CI: 0.185-0.976), respectively.

Conclusion: The elasticity of the patellar tendon decreased after the mechanical vibration intervention was applied, suggesting that such vibration might have beneficial effects in clinical applications to restore tendon elasticity.

References

1. Hsiao MY, Chen YC, Lin CY, Chen WS, Wang TG. Reduced Patellar Tendon Elasticity with Aging: In Vivo Assessment by Shear Wave Elastography. Ultrasound Med Biol 2015;41:2899-905.
2. Zhang ZJ, Fu SN. Shear Elastic Modulus on Patellar Tendon Captured from Supersonic Shear Imaging: Correlation with Tangent Traction Modulus Computed from Material Testing System and Test-Retest Reliability. PLoS One 2013;8:e68216.
3. Zhang ZJ, Ng GY, Lee WC, Fu SN. Changes in Morphological and Elastic Properties of Patellar Tendon in Athletes with Unilateral Patellar Tendinopathy and Their Relationships with Pain and Functional Disability. PLoS One 2014;9:e108337.

P9: Microcirculation in the proximal supraspinatus tendon and correlation to shoulder strength in badminton athletes: with dynamic contrast-enhanced MRI

Hsing-Kuo Wang[1], Chih-Wei Yu[2], Chao-Yu Hsu[2], Bang-Bin Chen[2], Hsin-Chia Chen[2], Tiffany Ting-Fang Shih[2]
[1] School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University; Center of Physical Therapy, National Taiwan University Hospital, Taiwan, ROC.
[2] Department of Radiology and Medical Imaging, National Taiwan University College of Medicine and Hospital, Taiwan, ROC.
***Presenting Author E-mail address:** hkwang@ntu.edu.tw*

Introduction: To measured the features of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) in the anterior and posterior portions of the supraspinatus tendon at the myotendinous junction, as well as the whole tendon, and investigated the correlations between the features and performances of shoulder performance in college overhead athletes.

Methods: Seventeen qualified badminton athletes were recruited. DCE-MRI was conducted on the tendons in each athlete's dominant arm, including measures for the volume transfer constant (K^{trans}), the extravascular extracellular space volume (V_e) and the plasma volume (V_p) per unit volume of tissue. The shoulder isokinetic tests were used to measure the acceleration time and the relative fatigue ratio of the shoulder external rotation of the arm.

Results: The DCE-MRI (median; K^{trans}, K_{ep}, V_e and V_p) for the anterior (0.031, 0.198, 18.04 and 0.31 respectively), posterior (0.067, 0.468, 18. 50 and 0.25), and entirety of the tendon (0.050, 0.325, 20.76 and 0.60) showed regional differences and correlations between the K_{ep} value for the whole supraspinatus tendon and the acceleration time (r =-0.663, p = 0.005), between the V_p values for the whole tendon and relative fatigue ratio (r =-0.605, p = 0.01). Median values of the acceleration time and relative fatigue ratio were 890.0 ms and 31.8% respectively.

Conclusions: There are differences of microcirculatory features between the anterior and posterior portion supraspinatus tendon, and also associations between the feature of the supraspinatus tendon and muscle performances. Intratendinous microcirculatory features at the myotendinous junction may vary with tendon morphomechanical adaptation to loadings.

P10: Correlations Between Patient-reported Outcomes and Functional Performances in Patients with an Achilles Rupture; Construction of the Taiwan Version of VISA-A

YP Chang[1]; WC Pong[2]; and HK Wang[1,2]
[1]Physical Therapy Center, National Taiwan University Hospital, Taipei, Taiwan, ROC,
[2]School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan.
***Presenting Author E-mail address**: r01428012@ntu.edu.tw*

Introduction: The purposes of the study were to construct the Taiwan Chinese version of the Victorian Institute of Sport Assessment Scale-Achilles (VISA-A) questionnaire (VISA-A-TC) for outcomes of subjects with an Achilles tendon rupture between 3 and 6 months postsurgery, to establish the questionnaire's validity and reliability, and to assess the correlations between the VISA-A-TC and functional performance in such subjects.

Methods: Fifteen subjects (13 males, 2 females; age, median: 44.6 years; range: 38.1 - 51.0 years) were recruited. Three subjects participated in a nine-step procedure to translate and adapt the VISA-A questionnaire into the VISA-A-TC. The other 12 subjects participated in tests to assess the test-retest reliability and validity of the VISA-A-TC, as well as three functional tests: the heel-raise test, star excursion balance test (SEBT) and one-leg hopping test.

Results: The VISA-A-TC showed good test-retest reliability (ICC=0.992) and internal consistency (Cronbach's alpha= 0.711 and 0.762, respectively, for the 1st and 2nd VISA-A-TC surveys). The VISA-A-TC was moderately correlated with the Lower Extremity Functional Scale, with concurrent validities for the 1st and 2nd VISA-A-TC surveys of rho= 0.697 and 0.680. The VISA-A-TC showed negative correlations with the differences between the un-injured and injured legs for the SEBT score and hopping distance (rho ranged between -0.655 and -0.671).

Discussion: The results indicate that the VISA-A-TC is appropriate for use by Chinese patients with an Achilles repair after rupture. In addition, self-reported physical functional limitations among these patients were associated with physical impairments that can be partially identified by simple physical tests.

References:
1. Robinson JM, Cook JL, Purdam C, Visentini PJ, Ross J, Maffulli N, et al. The VISA-A questionnaire: a valid and reliable index of the clinical severity of Achilles tendinopathy. Br J Sports Med 2001;35:335-41.

P11: Can delivery of mesenchymal stem cell aggregates enhance retention of cells at the site of injury in cell therapy of equine tendon?

Y Kasashima[1]; N Tamura[1]; Y Kotoyori[2]; K Fukuda[1]; T Kuroda[1] and Y Tabata[3]
[1]Clinical Science & Pathobiology Division, Equine Research Institute, Japan Racing Association (JRA), Japan; [2]Race Horse Hospital, Ritto Training Center, JRA, Japan; [3]Department of Biomaterials, Institute for Frontier Medical Sciences, Kyoto University, Japan.
***Presenting Author E-mail address**: kasashima@equinst.go.jp*

Introduction: Cell therapy using cultured mesenchymal stem cells (MSCs) is now a popular treatment for equine tendon injury. A major challenge to the success of the technology may be improving retention of cells at the site of injury as several studies have reported considerable cell loss post implantation [1]. In this study, the use of gelatin microspheres (GMS), which provide an injectable cell delivery vehicle without loss of cell attachment sites was explored [2]. We performed a tracking study of MSCs as cell aggregates compared to cells alone transplanted into a surgically induced lesion of SDFT.

Methods: The cell aggregates containing fluorescent-labelled MSCs (10^7) and GMS were used after incubation for 7 days and then injected into the left limb. Similarly labelled MSCs (10^7) recovered as a cell suspension from culture flask by trypsin were injected into the right limb. Superficial Digitorum Flexor Tendons (SDFTs) were harvested at 7 and 14 days (each n=1) and at 30 days (n=2) after transplantation and sections of the injury site were examined under a fluorescence microscope.

Results: The aggregates of labelled MSCs were observed in the lesion and a low fluorescence signal was observed within the endotenon at 7 days post transplantation. Migration of a few MSCs to areas adjacent to the aggregates was observed. Degradation of GMS was seen at 14 days. While, MSCs transplanted as single cell suspensions were located mainly within the endotenon with only small numbers present within the tendon fascicles at 7 days. At 30 days, similar results were seen in decreased fluorescence signal in the endotenon for both methods of cell delivery.

Discussion: Cell aggregates enhanced retention of MSCs in the lesion area for a longer time period than conventional single cell suspension. Initially the aggregates delivered cells within the tendon more effectively than cells alone. However, the viability and presence at the injury site of the MSCs 30 days post implantation was similar for both methods. Since GMS can deliver both cells as well as biomolecules simultaneously, further research is needed to explore this delivery method to combine cells and other active molecules with potential to enhance regeneration of the tendon.

References
1. Guest *et al*, Equine Vet J, 42(7): 636-642, 2010
2. Hayashi *et al*, Acta biomaterialia, 7(7):2797-2803, 2011

P12: Good lumbopelvic stabilization is associated with patellar tendinopathy absence in athletes.

Luciana De Michelis Mendonça[1,2], Natália FN Bittencourt[1,3], Juliana M Ocarino[4], Sérgio T. Fonseca[1,4].
[1]Laboratório de Prevenção e Reabilitação de Lesões Esportivas - Universidade Federal de Minas Gerais - MG – Brasil; [2]Departamento de Fisioterapia - FCBS - Universidade Federal

dos Vales do Jequitinhonha e Mucuri - MG – Brasil; [3]NICE - Minas Tenis Clube - MG – Brasil; [4]Departamento de Fisioterapia - EEFFTO - Universidade Federal de Minas Gerais - MG - Brasil
***Presenting Author E-mail address**: lucianademichelis@yahoo.com.br*

Introduction: Some knee injuries are predicted by neuromuscular control of the trunk[1]. The bridge test with unilateral knee extension is used to assess pelvic girdle stability, which is important for injury prevention and performance[2]. However the relationship between the bridge test and patellar tendinopathy (PT) has not been explored. The purpose of this study was to investigate the association between effective performance of the bridge test and patellar tendinopathy in athletes.

Methods: One-hundred and twenty-five athletes, forty-two female and 83 male, from volleyball (n = 74) and basketball (n = 51) were evaluated. The sample had a mean age of 18.78 ± 5.5 years, mean height of 1, 78 ± 0.34 metres and mean body mass of 75.13 ± 15.18 kilograms. They were asked to perform three repetitions of the bridge test with unilateral knee extension with each lower limb. Quantitative analysis was performed by measuring the highest transverse plane pelvic drop angle in each repetition performed to allow the mean extraction from the three measurements collected on each lower limb. PT severity was determined by VISA-P questionnaire score (value bellow 80 points). Classification and Regression Tree (CART) was used to identify the bridge test parameters associated to PT presence and absence.

Results: The mean of transverse plane pelvic drop angle was 11.02^{o} (SD=5.1^{o}) with support of the dominant lower limb and 11.52^{o} (SD=5.7^{o}) with support of the non-dominant lower limb on the treatment table. CART model was accurate (p=0.017; area under the curve=62.5%) and showed a better prediction for PT absence. Athletes without PT showed transverse plane pelvic drop angle under 5.75^{o} on the dominant lower limb (n=14) or asymmetry between lower limbs under 9.2^{o} (n= 57).

Conclusion: The results showed that a good transverse plane pelvic control was associated with PT absence. Interestingly, different parameters of pelvic drop (absolute values and asymmetries) were necessary to enhance the CART model accuracy. It is recommended that bilateral assessment of the bridge test in athletes with unilateral PT is performed.

Keywords: stability, sport, injury, knee.

Acknowledgement: *Fundação de Amparo a Pesquisa do Estado de Minas Gerais (FAPEMIG), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)* and *Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).*

References:

1. Zazulak BT, Hewett TE, Reeves P, Goldberg B, Cholewicki J. Deficits in Neuromuscular Control of the Trunk Predict Knee Injury Risk: A Prospective Biomechanical-Epidemiologic Study. Am. J. Sports Med. 2007; 35; 1123.
2. Santos TR, Andrade JA, Silva BL, Garcia AF, Persichini Filho JG, Ocarino Jde M, Silva PL. (2014). Active control stabilization of pelvic position in the transverse plane: an evaluation of soccer players' performance. Physical Therapy in Sport,15(3), 189-193.

P13: Is knee valgus associated with patellar tendinopathy in jumping athletes?

Luciana De Michelis Mendonça[1,2], Natália FN Bittencourt[1,3], Juliana M Ocarino[4], Sérgio T. Fonseca[1,4].
[1]Laboratório de Prevenção e Reabilitação de Lesões Esportivas - Universidade Federal de Minas Gerais - MG – Brasil; [2]Departamento de Fisioterapia - FCBS - Universidade Federal dos Vales do Jequitinhonha e Mucuri - MG – Brasil; [3]NICE - Minas Tenis Clube - MG – Brasil; [4]Departamento de Fisioterapia - EEFFTO - Universidade Federal de Minas Gerais - MG - Brasil

***Presenting Author E-mail address**: lucianademichelis@yahoo.com.br*

Introduction: Literature shows that knee valgus is associated with anterior cruciate ligament injury and patellofemoral pain, however, the relationship between knee valgus and PT has never been investigated.[1] Knee valgus could impose rotational forces on the patellar tendon and overload the tissue asymmetrically. Several studies use the Victorian Institute of Sport Assessment Scale (VISA-P) questionnaire to clinically identify individuals with patellar tendinopathy (PT)[2]. VISA-P is a questionnaire adapted and validated for the Brazilian population, which quantifies patellar tendon pain and functional disability. The purpose of this study was to investigate the association of patellar tendinopathy and frontal plane knee projection angle in athletes.

Methods: Athletes assessed preseason, including single-leg decline squat bidimensional analysis, were invited to participate and signed a consent form. Inclusion criteria included participating regularly in sports team activities. The VISA-P score used to identify athletes with PT was 80 points. Fifty-eight female and 165 male (n = 223) athletes participated in this study with a mean age of 17.79 (SD = 4.7) years, body mass of 76.00 (SD = 13.7) kilograms and height of 1.85 (SD = 00.11) metres. Forty-four athletes participated in basketball and 135 in volleyball with a mean frontal plane knee projection angle of 6.87^{o} (SD=4.4^{o}) on dominant lower limb and 6.15^{o} (SD=4.2^{o}) on the non-dominant lower limb. Descriptive statistics were used to characterize the sample and VISA-P questionnaire profile. Prevalence ratio (PR) and confidence intervals (CI) were calculated to assess the association of VISA-P questionnaire score and frontal plane knee projection angle on the injured lower limb.

Results: The mean score of VISA-P questionnaire was 89.44 (SD = 13.79) and 44 athletes (19.73%) scored below 80 points. There was no association of VISA-P questionnaire score and frontal plane knee projection angle, PR = 1.24 (CI = 0.83-1.86).

Conclusion: The results showed that knee valgus was not associated with PT in volleyball and basketball athletes. Probably for PT the injury mechanism is more related to jumping demand associated with low knee flexion on landing.

Acknowledgement: *Fundação de Amparo a Pesquisa do Estado de Minas Gerais (FAPEMIG), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)* and *Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).*

References:

1. Munro A, Herrington L, Comfort P. Comparison of landing knee valgus angle between female basketball and football athletes: Possible implications for anterior cruciate ligament and patellofemoral joint injury rates. *Physical Therapy in Sport* 13 (2012) 259e264.
2. Visentini PJ, Khan KM, Cook JL, Kiss ZS, Harcourt PR, Wark JD. (1998). The VISA score: An index of severity of symptoms in patients with jumper's knee (patellar tendinosis). *Journal of Science and Medicine in Sport,* 1(1), 22-28.

P14: Is neovascularisation an indicator of subsequent tendon injury risk in horses?

N Tamura[1]; E Yoshihara[2]; K Kodaira[3]; T Kuroda[1]; K Fukuda[1]; and Y Kasashima[1]
[1]Clinical Science & Pathobiology Division, Equine Research Institute, Japan Racing Association (JRA), Japan; [2]Race Horse Hospital, Ritto Training Centre, JRA, Japan; [3]Race Horse Hospital, Miho Training Centre, JRA, Japan.
***Presenting Author E-mail address**: tamura@equinst.go.jp*

Introduction: Neovascularisation detected using power doppler ultrasonography (PDU) is often observed in examination for tendinopathy (even in routine scans of clinically asymptomatic tendons). However, the exact role of neovascularisation remains an issue of contention. The potential value of neovascularisation as a prognostic indicator of injury is not clear [1].

The aim of this study was to test the hypothesis that the risk of tendon injury in racehorses with tendon Neovascularisation-Positive (NP) is higher than those with Neovascularisation-Negative (NN). We also evaluated the association between the risk of tendon injury and the length of rest periods in racehorses, from initial PDU (baseline) to the next race start.

Methods: A prospective cohort study of 98 racehorses with slight peritendinitis determined by clinical conditions but not overt superficial digital flexor tendon (SDFT) injury at baseline was conducted. The presence of neovascularisation in SDFT was defined as positive signal depicted with PDU at baseline. A subsequent SDFT injury was defined as diagnosis by veterinarians with grey-scale ultrasonography. Rest period was calculated from the official record. Hazard ratios (HR) comparing hazard of SDFT injury were calculated using Cox proportional hazards regression.

Results: The NP group comprised 43 racehorses (43.9%). The rates of SDFT injury in the NN and NP groups were 2.50 and 5.21 injuries/100 horse-months, respectively. The hazard in NP group was significantly greater (HR 2.38, 95% CI 1.15-5.20, P = 0.023). In subpopulation analysis of the NP group, the rates of SDFT injury in racehorses within 100 days rest periods and it with over 100 days were 2.10 and 7.21 injuries/100 horse-months, respectively. The hazard in the racehorses with over 100 days rest periods was significantly lower (HR 0.32, 0.07-0.95, P = 0.039). This significant difference was not observed in the NN group.

Discussion: There was a significant positive relation between the presence of neovascularisation inside the tendon and subsequent SDFT injury. This study suggested that an increasing neovascularisation inside the tendon would be an important prognostic indicator of tendon injury, and that the risk may decrease by observingan appropriate rest period following identification of neovascularisation.

References

1. Mahieu *et al*, Br J Sports Med, 48:A38, 2014

P15: The mechanical properties of scaffolds for rotator cuff repair

RDJ Smith[1], N Zargar[1], CP Brown[1], NS Nagra[1], SG Dakin[1], SJ Snelling[1], O Hakimi[1], A Carr[1]
[1]Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Old Road, Oxford, OX3 7LD, UK.
***Presenting Author E-mail address**: stephanie.dakin@ndorms.ox.ac.uk*

Introduction: Re-tearing following rotator cuff surgery is a major clinical problem. Numerous scaffolds are being used to try and reduce re-tear rates, however, few have demonstrated clinical efficacy. We hypothesise that this lack of efficacy is due to deficiency in their mechanical properties. We therefore compared the macro and nano/micro mechanical properties of 7 commercially available scaffolds to those of the healthy human supraspinatus tendons, whose function they seek to restore.

Methods: The clinically approved scaffolds tested were X-Repair, LARS ligament, Poly-Tape, BioFiber, GraftJacket, Permacol, and Conexa. Fresh-frozen cadaveric human supraspinatus tendon samples were used as a comparator. Five samples of each material were used per experiment. Macro mechanical properties were determined through tensile testing (deben stage), suture pull out (Zwick machine) and rheometry (rheometer). Scanning probe microscopy and scanning electron microscopy were performed to assess the morphology, Young's modulus, and loss tangent of materials at the nano/micro scale.

Results: None of the scaffolds tested adequately approximated both the macro and micro mechanical properties of healthy human supraspinatus tendon. Macroscale mechanical properties were insufficient to restore load-bearing function. X-Repair, ($p \leq 0.001$), LARS ligament ($P \leq 0.01$), and Poly-Tape ($p \leq 0.05$) experienced tensile failure at forces significantly higher than all other scaffolds. X-Repair ($p \leq 0.001$) had the greatest suture-retention of all scaffolds tested. However, these synthetic scaffolds had nano/microscale properties that were significantly different to native supraspinatus

tendon. Scaffolds approximating tendon properties on the nano/microscale, including GraftJacket, Permacol, Conexa, and BioFiber had poor macroscale properties.

Discussion: Our results suggest that generic scaffolds require modification to restore mechanical function across hierarchical levels. We recommend biological scaffolds be supplemented with a higher-strength, suture-friendly material in order to provide adequate mechanical response when applied to rotator cuff repair. By determining the mechanical properties of each scaffold relative to native tissue, this study can help surgeons determine the scaffold most appropriate for clinical use.

P16: T cell activation profiles in early supraspinatus tendinopathy point towards a Th1 phenotype

SG Dakin[1]; R Hedley[1]; MH Al-Mossawi[1]; S Kiriakidis[1]; P Taylor[1]; K Wheway[1]; B Watkins[1]; AJ Carr[1]

[1]Botnar Research Centre, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, United Kingdom.

***Presenting Author E-mail address**: stephanie.dakin@ndorms.ox.ac.uk*

Introduction: There is a growing body of evidence to support the contribution of inflammation to the onset and progression of tendinopathy. Whilst immune cells such as T cells have been identified in diseased human tendons (*1, 2*), little is known of their phenotype or the pro-inflammatory mediators they potentially release. In this study, we investigate the activation profiles of T cells in samples of early stage diseased human supraspinatus tendons and their capacity to release pro-inflammatory cytokines.

Methods: Tendon biopsies were collected from patients with early stage supraspinatus tendinopathy (4 females, 2 males, aged between 27-71 years) under general anaesthesia prior to surgical sub-acromial decompression treatment. To investigate T cell phenotype, samples were digested and stained using a validated panel of T cell surface markers for Th1, Th2, Treg and Th17 activation. To investigate the capacity of activated T cells to release IFNγ, TNFα and IL17A, tissue digests were stimulated with PMA (50ngmL^{-1}) and iomomycin (1μgmL^{-1}) for 4 hours at 37°C and stained with a validated flow cytometry T cell effector panel. Isotype and unstained controls were run on peripheral blood mononuclear cells isolated from blood cones. Samples were run on a Fortessa flow cytometer and analysed using FlowJo software.

Results: CD45+ cells accounted for up to 23% of viable cells in tendon tissue digests (mean 7.6%, SEM 3.5%). Of the CD45+ cells, between 30-63% were CD3+ (mean 48%, SEM 4.6%). CD4$^+$ and CD8$^+$ T cells expressed CXCR3, suggestive of a Th1 activation signature. Markers for regulatory T cells and Th17 activation showed only low level expression, markers of Th2 activation were not expressed. IFNγ and TNFα were produced by CD4+ and CD8+ T cells in response to stimulation of tissue digests with PMA and Ionomycin, IL17A was not detected.

Discussion: The findings from this study suggest T cells have a Th1 activation profile in early stage supraspinatus tendinopathy. T cells in these samples have the capacity to release pro-inflammatory cytokines including IFNγ and TNFα. We propose this lymphoid population is likely an important contributor to the inflammatory phenotype frequently seen in samples of early stage supraspinatus tendinopathy.

Acknowledgements: This work was funded by Arthritis Research UK grant 20506 and the NIHR Oxford Musculoskeletal Biomedical Research Unit.

References:

1. M. S. Kragsnaes, U. Fredberg, K. Stribolt, S. G. Kjaer, K. Bendix, T. Ellingsen, Stereological quantification of immune-competent cells in baseline biopsy specimens from achilles tendons: results from patients with chronic tendinopathy followed for more than 4 years. *Am J Sports Med* **42**, 2435-2445 (2014).

2. N. L. Millar, A. J. Hueber, J. H. Reilly, Y. Xu, U. G. Fazzi, G. A. Murrell, I. B. McInnes, Inflammation is present in early human tendinopathy. *Am J Sports Med* **38**, 2085-2091 (2010).

P17: Development and optimization of a novel electrospun suture with potential for use in rotator cuff tendon repair

RE Abhari[1], PA Mouthuy[1], N Zargar[1], A Carr[1]
[1]NIHR Biomedical Research Unit, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, Botnar Research Centre, University of Oxford, OX3 7LD, UK
***Presenting Author E-mail address**: roxanna.abhari@ndorms.ox.ac.uk*

Introduction: Rotator cuff repairs often fail at the tendon-suture interface. Pull through of the suture through tissue is common, because the material characteristics are often not suitable to support the repair of the weak tendon. Novel sutures that mimic tendon architecture may improve patient outcomes. Recent *in vivo* data has shown that submicron electrospun fibres promote better attachment, growth and orientation of cells[1].
This work describes production of an electrospun suture with high tensile strength and relevant degradation rate for tendon healing.

Methods: A custom electrospinning setup with a single nozzle and stainless steel wire collector was designed to fabricate continuous filaments with different weight/volume ratios of polydioxanone (PDO). The filaments were stretched and annealed, or heat-treated, at various times and temperatures. *In vitro* degradation testing in PBS was done and samples characterized by tensile and material testing (scanning electron microscopy and differential scanning calorimetry) for up to 6 weeks.

Results: A 9% weight/volume ratio of PDO solution produced mechanically strong filaments made up of aligned fibres with a diameter around 1um. Annealing for longer than 6 hours significantly decreased the strain ($p < 0.0001$) and above 75˚C always weakened the material ($p < 0.0001$). Annealing for 3 hours at 65˚C was chosen, as only 15% and 34% of its strength and strain was lost, respectively, over a 6-week degradation period. Material testing indicated that these parameters led to a rearrangement of polymer crystalline regions, resulting in a more stable structure over time.

Discussion: This study examined important steps in the suture manufacturing process. We were able to produce electrospun filaments with fibres on a submicron scale and determine optimal annealing parameters. Our analysis of the material changes that occur during degradation will be useful for future efforts to tailor the mechanical properties to the functional demands of diseased tendon tissue. This work is relevant to the development of a biomimetic, absorbable suture with high tensile strength retention for use in tendon repair.

References:
1. Mouthuy P-A, Zargar N, Hakimi O, Lostis E, Carr A. Fabrication of continuous electrospun filaments with potential for use as medical fibres. *Biofabrication*. 2015;7(2):25006.

P18: Comparison of TGFβ expression in healthy and diseased human tendon

Henry CJ Goodier[1,2], Andrew J Carr[1,2], Sarah JB Snelling[1,2], Lucy Roche[1,2], Kim Wheway[1,2], Bridget Watkins[1,2] and Stephanie G Dakin[1,2]
[1]Botnar Research Centre, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Nuffield Orthopaedic Centre, Windmill

Road, Headington OX3 7LD, UK; [2]NIHR Oxford Biomedical Research Unit, Botnar Research Centre, University of Oxford, Windmill Road, Oxford OX3 7LD, UK
Presenting author email address: *hgoodier@gmail.com*

Introduction: Rotator cuff disease is a common cause of shoulder pain. Diseased tendons are characterised by fibrotic scar tissue, which adversely affects tendon structure and function and increases the likelihood of re-injury. Inflammation-mediated fibrosis is well documented in skin, liver, renal and pulmonary fibrotic diseases. However, little is known about the mechanisms by which fibrosis occurs in tendon disease. Transforming growth factor beta (TGFβ) and its associated superfamily are known to be key drivers of fibrosis and to modulate extracellular matrix homeostasis. We hypothesised that differential expression of TGFβ superfamily members would exist between samples of human rotator cuff tendons with established disease compared to healthy control tendons.

Methods: Healthy and diseased rotator cuff (supraspinatus) tendons were collected from patients presenting to an orthopaedic referral centre. Diseased tendinopathic (intact n=23) and healthy rotator cuff tendons (n=10) were collected via ultrasound-guided biopsy, torn tendons were collected during routine surgical debridement (n=30). Healthy hamstring tendons were collected from patients undergoing ACL reconstruction (n=*). Immunohistochemistry and quantitative real-time polymerase chain reaction were used to investigate the expression profiles of TGFβ superfamily members in these healthy and diseased tendon tissues.

Results: TGFβ superfamily members were dysregulated in diseased compared to healthy tendons. Specifically, TGFβ-1, TGFβ receptor R1 and TGFβ R2 proteins were reduced ($p<0.01$) in diseased compared to healthy tendons. At the mRNA level, TGFβ R1 was significantly reduced in samples of diseased tendons, whereas TGFβ R2 was increased ($p<0.01$).

Discussion: We propose that down regulation of TGFβ pathways in established tendon disease may be a protective response to limit disease-associated fibrosis. Disruption of the TGFβ axis with disease suggests associated downstream pathways may be important for maintaining tendon homeostasis and health. The findings from our study suggest that patients with established tendon disease would be unlikely to benefit from therapeutic TGFβ blockade, which has been investigated as a treatment strategy in several animal models. Future studies should investigate the expression profile of fibrotic mediators in earlier stages of tendon disease to improve understanding of the targetable mechanisms underpinning tendon fibrosis.

P19: Incidence of lower limb tendinopathy in Brazilian youth athletes

Natália FN Bittencourt[1,2], Luciana De Michelis Mendonça[3], Daniel Freitas Maciel[4], Gabriela GP Gonçalves[4], Rodrigo Vaz[4]
[1]Sports Physical Therapy Department – Minas Tênis Clube, Brazil ; [2]Centro Universitário Uni-BH- Brazil ; [3]Physical Therapy Department - Universidade Federal dos Vales do Jequitinhonha e Mucuri, Brazil; [4]Sports Science and Medicine Department- Minas Tênis Clube, Brazil
Presenting Author E-mail address: *nataliabittencourt@yahoo.com.br.*

Introduction: The incidence of lower limb tendinopathy (LLT) has been documented in elite athletes[1], but in youth athletes the incidence is unclear. Van Mechelen proposed that the first step to properly prevent sports injury is to determinate the injury profile in a specific population[2]. Preventing LLT is important, because rehabilitation is complex and this injury may result in long-standing impairment of athletic performance. The purpose of this study was to investigate the incidence of LLT in Brazilian youth athletes.

Methods: A one-year prospective study was performed in 442 Brazilian youth athletes from volleyball, basketball, judo, gymnastic, tennis and indoor soccer (113 female and 329 male). The sample had a mean age of 14.1 ± 2.9 years, mean height of 1.75 ± 1,2 meters and mean body mass

of 59.4 ± 17.4 kilograms. The examination included questioning around individual characteristics (weight, age, height, and training background) and a physician performed the diagnosis of tendinopathy clinically. To be classified as having LLT, participants met the eligibility criteria of: lower limb tendon pain on at least one of jumping/landing, running or changing directions and pain on palpation of the LLT tendon [3,4].

Results: From 221 injuries, tendinopathy was the main complaint (24%), followed by ligament injury (22%). The LLT overall incidence rate was 10.7/1000 exposure hours (CI 95%: 7.0-14.4). The frequency of current symptoms was higher in male volleyball athletes (28%), followed by Judo, basketball and female volleyball players (16% each one) and the lowest frequency was in gymnastic, tennis and indoor soccer (5% each one). Patellar tendon was the most injured (47%), followed by Achilles tendon (16%) and adductor tendon (2%). Male athletes (72%) had higher frequency of tendinopathy than female athletes (28%).

Conclusion: The results showed higher incidence of tendinopathy in youth athletes (14,5%) compared to the literature. For example, Cassel et al reported prevalence of 7,8% of LLT in German youth athletes[3]. As in elite athletes, volleyball had the higher prevalence of tendinopathy. Interesting, judo athletes had the same frequency than basketball. Therefore, youth athletes are at high risk of LLT and it is necessary to assess these athletes in the pre-season in order to identify factors that could be associated to LLT and plan an effective prevention program.

References:

1. Lian OB, Engebretsen L, Bahr R. Prevalence of jumper's knee among elite athletes from different sports: a cross-sectional study.Am J Sports Med. 2005 Apr;33(4):561-7. Epub 2005 Feb 8.
2. Van Mechelen W., Hlobil H., Kemper H.C.G. Incidence, severity, aetiology and prevention of sports injuries. Sports Medicine, v14, n.2, p: 82-99, 1992.
3. Cassel M, Baur H, Hirschmüller A, Carlsohn A, Fröhlich K, Mayer F. Prevalence of Achilles and patellar tendinopathy and their association to intratendinous changes in adolescent athletes. Scand J Med Sci Sports 2015: 25: e310–e318.
4. Cook JL, Khan KM, Kiss ZS, et al. 2001. Reproducibility and clinical utility of tendon palpation to detect patellar tendinopathy in young basketball players. Br J Sports Med 35:65 – 69.

P20: Effect of iso-inertial squat on incidence of patellar tendinopathy in elite male soccer players

Bruno Mazziotti [1,4,5], Natalia FN Bittencourt[2,3], Luciano Rosa [1,4], Caio Mello [1], Joaquim Grava[1], Cesar Amorim[5],

[1]Biomechanics Laboratory. - S. C. CORINTHIANS PAULISTA, São Paulo – Brazil; [2] Sports Physical Therapy Department – Minas Tênis Clube, Brazil;[3] Centro Universitário Uni-BH-Brazil; [4] Mechanical Engineering Department – FEG/UNESP,São Paulo – Brazil;

[5]Universidade Cidade de São Paulo, São Paulo, Brazil

Presenting Author E-mail address: *brunomazziotti@hotmail.com*

Introduction: Patellar tendinopathy (PT) is common in elite soccer and the recurrence rate is high[1]. This condition could be related to ACL reconstruction or overuse due to high amount of exposure. Typical soccer performance involves acceleration and deceleration at high intensity of a constant mass. Iso-inertial squat exercises (yoyo system) have those same characteristics during concentric and eccentric work [2]. This is more similar to athletic performance than isokinetic and isometric exercises[2]. Moreover, it could promote specific load to muscle and tendon tissue and increase tensile strength. The purpose of this study was to investigate the effect of iso-inertial exercises on incidence of patellar tendinopathy in elite male soccer players.

Methods: Thirty elite male soccer players from Brazilian first division were recruited and followed during one season (10 months). The sample had mean age of 26.24±5.17 years, mean height of 1.79 ± 0.06 meters and mean body mass of 78.58 ± 7.58 kilograms. All athletes performed typical strength

conditional training and they were exposure to the same 380 hours of soccer matches and training session. Group A (n=15) didn't perform iso-inertial exercises and Group B (n=15) did iso-inertial squat two times a week (6 x 10 repetition).

Results: Group A had 7 cases of PT and group B (iso-inertial exercises) had 3 cases of PT. This study presented a decrease of 57% in PT frequency on iso-inertial squat group.

Conclusion: The results showed a lower incidence of patellar tendinopathy in elite male soccer athletes, which performed yoyo iso-inertial squat exercises during a season. These preliminary data might indicate that tendon tissue benefits from exercises that involve acceleration and deceleration of a constant mass.

References:

1. Hägglund M1, Zwerver J, Ekstrand J. Epidemiology of patellar tendinopathy in elite male soccer players. Am J Sports Med. 2011 Sep;39(9):1906-11. doi: 10.1177/0363546511408877.
2. Murphy, A.J., Wilson G.J. and Pryor J.F. (1994) Use of the iso-inertial force mass relationship in the prediction of dynamic human performance. Eur J AP Physiol. 69: 250-257.

P21: Temperature differences in affected compared with unaffected legs in subjects with unilateral Achilles tendinopathy: A pilot study

S O'Neill,[1]; C Swan[1]; L Mclelland[2]; T Coats[2] ;M Sims[3].
[1]Department of Medicine, University of Leicester, United Kingdom; [2]Emergency Medicine Academic department, Leicester Royal Infirmary, United Kingdom; [3]Department of Physics and Astronomy, University of Leicester, United Kingdom.
***Presenting Author E-mail address**: so59@leicester.ac.uk*

Introduction: Achilles tendinopathy is associated with neovascularization, and metabolic changes. Autonomic nervous system alterations, such as changes in the colour and temperature of the overlying skin, are often observed. Multiple authors have suggested that thermography may be useful clinically and in research. There are several small studies on equine and human tendinopathic tendons suggesting alterations to overlying skin temperature but no quantitative measurements.

Aim
Determine if there are between limb differences in subjects with Achilles tendinopathy

Methods: Observational study involving 16 subjects with chronic Achilles tendinopathy. A standardized protocol was developed using a template to position the participant. This template positioned the subject 120cm from the thermal camera (forward looking infrared (FLIR) SC620 camera with thermal sensitivity of <0.04˚C at 30˚) with the camera mounted level with the Achilles tendon (10cm from the floor). Stable environmental conditions were used for all subjects with equal time for each participant to acclimatize to the environment. Initially two regions of interest (ROI) were determined. These were the site of most tenderness and the posterior of the calcaneus. Analysis involved limb comparison between affected and un-affected limbs.

Results: At the site of most tenderness the affected leg measured 28.0°C (CI 26.8-29.2) and the control (unaffected) leg measured 28.1°C (CI 26.9-29.3), a difference of 0.075°C (p=0.705, non-significant). The 2ndROI (calcaneus) measured 0.5°C cooler on the affected side at 26.2°C (CI 25.1-27.4) compared with the un-affected side of 26.7°C (CI 25.5- 27.9) (p=0.018).

Discussion: In this preliminary study in individuals with unilateral Achilles tendinopathy there was no difference in temperature at the site of most tenderness between the affected and un-affected limbs. This could be related to central or bilateral changes or there may indeed be no effect of tendinopathy on skin temperature. At the 2ndROI (posterior of the calcaneus) the affected limb was cooler – a difference that was small, but higher than the accepted difference between limbs of 0.38°C. This

preliminary study did not find the previously suggested pattern of temperature difference; further work is warranted to understand the complex changes and to further elucidate the potential place of thermal imaging in Achilles tendinopathy.

P22: Is widespread mechanical sensitivity a feature of Achilles tendinopathy?

S O'Neill,[1]; R Masterton
[1]Department of Medicine, University of Leicester, United Kingdom.
***Presenting Author E-mail address**: so59@leicester.ac.uk*

Introduction: Tendinopathy research has recently begun to assess the changes that occur in the central nervous system. The majority of these studies have focussed on the upper limb with only two assessing lower limb tendinopathy. Much of this research has focussed on whether the central nervous system becomes mechanically hypersensitive in the same way as observed in upper limb tendinopathy or other chronic MSK conditions. Only one small pilot (n=8 in each group) study has assessed mechanical sensitivity in relation to Achilles tendinopathy. Due to the gap in the literature this study aimed to determine if individuals with chronic Achilles tendinopathy present with widespread mechanical hyperalgesia.

Methods:
Observational case control study. 17 subjects with chronic Achilles tendinopathy, mean age 49, and 15 Healthy controls, mean age 40, were recruited. Mechanical sensitivity was assessed using an electronic Von Freys device. 5 points were used – Achilles tendon, Lateral Femoral condyle, abdominal wall, anterior forearm and Ulnar styloid process. Testing was completed by the same experienced user.

Results:
Skin sensitivity for each area is reported as mean and (SD) in grams, with the AT group versus the control. Achilles tendon 304.4(171.8): 340.2 (134.6), Lateral Femoral condyle 409.2 (164.7):450.7 (191), abdominal wall 362.8 (144.3):346.4 (158.2), anterior forearm 338.6 (144.8): 345 (163.7) and Ulnar styloid 424.9 (168):381.7 (200.6). For each of the 5 areas measured there was no statistical or clinically important between group differences: Achilles tendon (p=0.521), Lateral Femoral condyle (p=0.514) abdominal wall (p=0.761), anterior forearm (p=0.906) and Ulnar styloid process (p=0.512). VISA A score did not correlate to mechanical sensitivity of the Achilles tendon (p=0.146).

Discussion: Widespread mechanical hyperalgesia does not appear to be a feature of Achilles tendinopathy. This finding supports previous research findings [1] and suggests that Achilles tendinopathy does not invoke widespread mechanical hyperalgesia. This finding does not mean that central sensitisation does not occur in Achilles tendinopathy [2] but rather that it does not influence mechanical hyperalgesia. This seems to correspond to the common clinical presentation and diagnostic criteria of localised tendon pain.

References
1. Skinner, I,W. Debenham, J, R. Krumenacher, S, A. Bulsara, M, K. Wand, B, M. (2014) *'Chronic Mid Portion Achilles Tendinopathy is Not Associated with Central Sensitisation'.* Pain and Rehabilitation- The Journal of the Physiotherapy Pain Association. (37) 34-40
2. Tompra, N. Dieen, J. Coppieters, M. (2016) Central pain processing is altered in people with Achilles tendinopathy. British Journal of Sports Medicine. 0, p1-6. doi:10.1136/bjsports-2015-095476

P23: Acute sensory and motor response to 45-seconds heavy isometric holds for the plantar flexors in patients with Achilles tendinopathy

S O'Neill,[1]; J Radia[1]; K Bird[1] ;MS Rathleff[2]; T Bandholm[3] ; M Jorgensen[4] and K Thorborg[5]
[1]Department of Medicine, University of Leicester, United Kingdom; [2]Research Unit for General Practice in Aalborg and Department of Clinical Medicine, Aalborg University, Denmark;[3] Physical Medicine & Rehabilitation Research – Copenhagen (PMR-C), Amager-Hvidovre Hospital, University of Copenhagen, Copenhagen, Denmark; [4] Department of Geriatrics, Aalborg University Hospital, Denmark; [5]Sport Orthopedic Research Center – Copenhagen (SORC-C), Amager-Hvidovre University Hospital, Copenhagen, Denmark
***Presenting Author E-mail address**: so59@leicester.ac.uk*

Introduction: Recent studies have suggested that heavy isometric exercises for the quadriceps improve pain and muscle function in subjects with patella tendinopathy [1]. It is unclear whether this approach is effective for other lower limb tendon pain.

Aim – To investigate the immediate effects of heavy isometric exercises of the plantarflexors on pain output and muscle force output in individuals with Achilles tendinopathy.

Methods: 16 individuals (5 Female) with Achilles tendinopathy for more than three months participated. Pain response (0-10) to most provocative Achilles activity (heel raises or hopping) was recorded and rated using the numerical rating scale (NRS). Participants then underwent Mechanical pressure pain threshold testing using an electronic von freys device and strength testing using an isokinetic dynamometer to measure plantarflexor strength. Subjects had their maximal voluntary isometric strength measured and completed five 45-second isometric contractions – separated by 2 minute rest, at 70% MVC using a Fysiometer [2]. Pain sensitivity and strength were assessed immediately after completion of the exercise protocol.

Results: Only 9 of the 16 participants reported pain during either heel raises or hopping. Mean (SD) NRS for the symptomatic test was 4.2(1.9) pre intervention and 4.8 (3.2) post intervention, p=0.219. Mechanical pressure pain thresholds did not change from pre 335.8N (193.7) to post 313.1N (176.4) intervention (p=0.396). Concentric plantarflexor torque at 90º/sec increased 6 Nm (13%) from pre 47(14.5)Nm to post 53(18.5)Nm intervention (p=0.039). No other changes in plantarflexor strength were observed across contraction modes and speeds: concentric 225º/sec, 34(11.6)Nm versus 33(6.6)Nm (p=0.917); eccentric 90º/sec, 99(34.2)Nm versus 107(41.4)Nm (p=0.350).

Discussion: In patients with Achilles tendinopathy, heavy isometric exercises – did not acutely change sensory and motor output to a clinically relevant degree. Although a small increase in concentric plantarflexor torque at 90º/sec was observed, this is less than the smallest detectable change for this measure. Furthermore, the clinical value of NRS testing during functional testing in patients with Achilles tendinopathy seem a doubtful approach as floor effect presented in many patients. This preliminary study suggests that patients with Achilles tendinopathy may not respond to heavy isometric holds in the same way as patients with patellar tendinopathy.

References

1. Rio E, Kidgell D, Purdam C, Gaida J, Moseley L, Pearce A, et al. Isometric exercise induces analgesia and reduces inhibtion in patellar tendinopathy. British journal of sports medicine 2015;49(19):1277-1283.
2. Blomkvist AW, Andersen S, deBruin ED, Jorgensen MG Isometric hand grip strength measured by Nintendo wii balance board - a reliable new method. BMC musculoskeletal Disorders 2016:3(17): doi: 10.1186/s12891-016-0907-0.

P24: An Investigation into the Effect Different Window Size Analysis has on Achilles Tendon Ultrasonographic Tissue Characterisation Echo-type Quantification.

S Barry[1]; S O'Neill[2]

[1]*Faculty of Health and Life Sciences, Coventry University, UK,* [2] *Department of Medicine and Biological Sciences, University of Leicester, UK*
Presenting Author E-mail address: *sjb111@le.ac.uk*

Introduction: Grey scale Ultrasonography (US) is a commonly used modality to visualise tendon structure having the capacity to allow accurate measurement of tendon thickening and identification of hypoechogenicity to aid the diagnosis of tendon pathology. However, routine Ultrasonography relies on subjective quantification of tendon pathology and is not responsive to subtle changes in tendon structure. Ultrasonographic Tissue Characterisation (UTC) provides a detailed visulisation of tendon matrix structure and quantification of 4 echo-types indicating the degree of tendon bundle alignment. The UTC standardizes many US parameters but offers 3 distinct options for scan analysis referred to as Window Sizes (WS). This study investigates the effect that WS has on echo-type quantification.

Methods: Twenty participants with no history of Achilles tendinopathy were recruited. A 4cm section of the mid-portion of both Achilles tendons was scanned in a standardized prone position producing 200 contiguous transverse images which were automatically interpolated to form a tendon volume. Tendon structure was quantified using dedicated UTC algorithms for WS 25, 17 and 9.

Results: A reduction in percentage of echo-type I was seen as the WS reduced, (WS: mean (SD)), 25:73.61% (5.96); 17: 69.91% (5.46); 9: 64.65% (4.59). All other echo-types increased, echo-type II 25:25.54% (5.89); 17:28.71% (5.29); 9:32.62% (4.35), echo-type III 25:0.59% (0.48); 17: 0.96% (0.67): 9:1.39% (1.14), echo-type IV 25:0.27% (0.35); 17: 0.4% (0.42); 9:0.71% (0.58). However, the echo-type values for each corresponding WS remained highly correlated Echo-type I 25:17:9 r = 0.998:0.998:0.993; Echo-type II 25:17:9 r = 0.997:0.984:0.969: Echo-type III 25:17:9 r = 0.990:0.981:0.948; Echo-type IV 25:17:9 r = 0.99:0.983:0.966.

Discussion: UTC analysis is becoming more prevalent in tendinopathy research however studies do not always state which WS was used for scan analysis. To date most studies have used WS 25 despite indications that smaller WS improve scan resolution and therefore ability to detect small scale changes. Study results indicate that UTC analysis in different WS significantly alters the quantification of echo-types I-IV demonstrating proportionally fewer aligned tendon bundles in smaller WS. However the echo-type values for each corresponding WS were highly correlated indicating high internal validity for UTC analysis of tendon structure.

P25: An exploration of intron 4 polymorphisms within the *COL5A1* gene and its association to anterior cruciate ligament injury risk

F Firfirey[1]*, M-J Laguette*[1]*, AV September*[1]*,M Collins*[1]
[1]*Division of Exercise Science and Sports Medicine, Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa.*
Presenting Author E-mail address: *Firzanafirfirey@gmail.com*

Background: Anterior Cruciate Ligament (ACL) injury is a multifactorial condition and one of the most common musculoskeletal soft tissue injuries in competitive sports. To date, several genetic association studies have identified polymorphisms which alter an individual's risk of injury. The *COL5A1* gene is an important regulator of collagen fibrillogenesis in ligaments and tendons. Previous studies have identified sequence variants within the 3'-UTR of *COL5A1* resulting in altered *COL5A1* mRNA stability. Regions within intron 4 have been implicated in splicing. The objective of this study was therefore to examine the relationship between polymorphisms in intron 4 of *COL5A1* and ACL injury risk.

Methodology: A case control genetic association study was conducted. South African participants recruited for this study included 253 cases (152 non-contact and 101 contact ACL injuries) and matched 233 asymptomatic controls from which venous blood were obtained for DNA extraction. Two single nucleotide polymorphisms (SNPs), rs4841926(C/T) and rs3922912 (A/G), were identified using HaploReg V3 and the SeattleSNPs databases. HaploReg V3 were set to identify SNPs of 0.8 linkage disequilibrium within a 1000 base pairs. The genome variation server in the Seattle database was

used to identify tagged SNPs and confirm the results obtained in HaploReg. The samples were genotyped using Taqman® assays through real-time polymerase chain reaction (RT-PCR). Fisher's exact test and Pearson's *Chi squared* analysis were used to analyse differences in genotype and allele frequencies. Genotype and allele frequencies were also stratified according to mechanism of injury and gender. Statistical significance was accepted at $P < 0.05$.

Results: No statistical differences in genotype or allele frequencies were observed for *COL5A1* rs4841926 (P=0.6893) and rs3922912 (P=0.3895) between the case and control diagnostic groups. Furthermore, no statistical differences were noted when diagnostic groups were stratified by gender or mechanism of injury.

Conclusion: No genetic associations were identified in this study. However, future studies should examine a wider region in a larger sample size to allow for risk specific haplotypes to be identified.

P26: Investigating an *in silico* approach to identify genetic susceptibility loci for musculoskeletal soft tissue injuries

S Dlamini[1], C Saunders[2], M Collins[1], J Gamieldien[2], A September[1]
[1]Division of Exercise Science and Sports Medicine, Department of Human Biology, University of Cape Town, South Africa, [2]South African National Bioinformatics Institute University of Western Cape
***Presenting Author E-mail address**: dlaminisenanile@gmail.com*

In competitive and recreational athletes, musculoskeletal injuries of soft tissues such as ligaments and tendons are common. To date, most of the genes and genetic loci implicated were identified through a case-control, candidate gene association approach. Based on all the information that has been obtained through candidate gene association studies, the aim of this study was to use an *in silico* approach where bioinformatics was included to find new information through assessing the feasibility and performance of BioOntological Relationship Graph database (BORG), an *in silico* tool which integrates multiple sources of genomic and biomedical knowledge into an on-disk semantic network where human genes and their orthologs in mouse and rat are central concepts mapped to ontology terms. BORG was used to identify a comprehensive list of potentially biologically significant genetic loci to be tested for association with risk of Achilles Tendinopathy and Anterior Cruciate Ligament injury. The list was then compared and refined using next generation sequencing data. From screening all human genes, 3500 genes and a further 10 microRNA's were found to be linked to tendinopathy. Further preliminary characterisation has shown that these genes are differentially expressed in tendinopathy, functionally linked to features of tendinopathy either through signalling or pathways etc.

P27: The *CASP8* gene and risk of carpal tunnel syndrome

K Seale[1], MC Burger[1], H de Wet[2], A September[1], M Posthumus[1], M Collins[1]
[1]Division of Exercise Science and Sports Medicine, Department of Human Biology, University of Cape Town, South Africa; [2]Life Occupational Health, Life Healthcare, Cape Town, South Africa
***Presenting Author E-mail address:** Kirsten.Seale@alumni.uct.ac.za*

Introduction: Idiopathic carpal tunnel syndrome (CTS) is a commonly occurring mono-neuropathy in the upper limb, of which the direct cause remains unknown. Although primarily considered a neuropathy, the possible involvement of the flexor tendons in the pathogenesis of CTS has been proposed, and in support of this, tendinopathy and tenosynovitis have both been mentioned as possible precursors for CTS. In addition, the role of genetics in the pathogenesis of this condition is plausible, and recent research has identified DNA sequence variants within genes encoding structural

components of tendons and tendon regulatory proteins to modulate risk of CTS. The aim of this study was to determine whether sequence variants within the *caspase-8 (CASP8)* gene, a primary operator in the apoptosis pathway, are also associated with CTS. Sequence variants within the *CASP8* gene have been previously associated with risk of Achilles tendinopathy (AT), a multifactorial overuse pathology[1].

Methods: One hundred and three self-reported Coloured South African participants, with a history of carpal tunnel release surgery (CTS) and one hundred and forty-seven matched control (CON) participants without any reported history of CTS symptoms were genotyped using the TaqMan® allelic discrimination method (Applied Biosystems, Foster City, California, USA) for the *CASP8* rs3834129 (I/D), rs1045485 (G/C) and rs13113 (T/A) sequence variants. All statistical analyses were performed on the programming environment R and R packages.

Results: No independent associations were found for all three of the *CASP8* variants between the CTS and CON groups. Two inferred haplotype combinations (rs3834129-rs1045485-rs13113 and rs3834129-rs13113) were, however, found to have a significant relationship with CTS in all participants and in females separately.

Discussion: Variants within the *CASP8* gene have been found to be collectively significantly associated with CTS, implicating the apoptosis pathway as biologically significant in the underlying pathogenesis of CTS. The main focus of this research is aimed at underpinning the genetic susceptibility to CTS, and how associated variants may contribute to the inter-individual variation in tendon structure and function. The identification of genetic risk factors pertaining to CTS may potentially provide insight into the management of injury in susceptible individuals.

References:

1. Nell, E.M., Van Der Merwe, L., Cook, J., Handley, C.J., Collins, M., and September, A. V. (2012). The apoptosis pathway and the genetic predisposition to Achilles tendinopathy. J. Orthop. Res. *30*, 1719–1724.

P28: Genetic variants in the proteoglycan, decorin and risk of carpal tunnel syndrome.

JL Judd[1]; M Burger[1]; H De Wet[2]; M Collins[1]

[1]Division of Exercise Science and Sports Medicine, Department of Human Biology, University of Cape Town, PO Box 115, Newlands 7725, South Africa; [2]Life Occupational Health, Western Cape, South Africa

***Presenting Author E-mail address**: jddjen001@myuct.ac.za*

Introduction: Carpal tunnel syndrome (CTS) is generally considered to be a multifactorial condition and causal factors are still under debate[1]. Although primarily considered to be a neuropathy, recent evidence suggests that tendinopathy may be involved in the aetiology of CTS. Anatomically, the carpal tunnel structure contains nine flexor tendons indicating that entrapment of the median nerve within this structure, leading to an increase in pressure, could in part, be attributed to these tendons. Variants within genes encoding the essential structural components of tendons have previously been associated with risk of CTS[2-4]. The *DCN* rs516115 (A/G), within the gene encoding decorin, an important proteoglycan, has previously been associated with altered risk of musculoskeletal soft tissue injuries (Collins et al., 2015) and therefore the aim of this study was to determine whether *DCN* rs516115 (A/G) was independently associated with altered risk of carpal tunnel syndrome.

Methods: A total of 71 self-reported Coloured participants with a history of CTS release surgery and 100 appropriately matched controls have thus far been genotyped for the *DCN* rs516115 (A/G) variant. A Pearson's Chi-squared test was used to determine any significant differences between genotype distributions or any other categorical data of the groups.

Results and Discussion: Preliminary results indicate that there is no significant difference between cases and controls, for the *DCN* rs516115 variant (p=0.933). It is however important to note that the

sample size of this study is small and the findings need to be repeated in other, larger studies. Additionally, this finding does not exclude other variants within *DCN* to potentially alter risk of CTS.

References:
1. McDiarmid, M., Oliver, M., Ruser, J., & Gucer, P. (2000). Male and female rate differences in carpal tunnel syndrome injuries: personal attributes or job tasks? Environmental Research, 83(1), 23–32.
2. Burger, M. C., De Wet, H., & Collins, M. (2014). The BGN and ACAN genes and carpal tunnel syndrome. Gene, 551(2), 160–166.
3. Burger, M., De Wet, H., & Collins, M. (2014). The COL5A1 gene is associated with increased risk of carpal tunnel syndrome. Clinical Rheumatology, 34(4), 767–774.
4. Collins, M., September, A. V, & Posthumus, M. (2015). Biological variation in musculoskeletal injuries : current knowledge, future research and practical implications. British Journal of Sports Medicine, 49, 1–8.

P29: Evaluating polymorphisms within the proteoglycan encoding genes with Achilles tendinopathy susceptibility

K Willard[1]; Laguette M-J[1]; CJ Saunders[2]; J. Gamieldien[2]; M Collins[1]; and September AV[1]
[1]Division of Exercise Science and Sport Medicine, Department of Human Biology, University of Cape Town, [2]South African National Bioinformatics Institute/MRC Unit for Bioinformatics Capacity Development, University of the Western Cape
***Presenting Author E-mail address**: k14581035@gmail.com*

Introduction: Compromised functional capacity of tendons and ligaments has been associated with musculoskeletal soft tissue (MSK) injuries such as Achilles tendinopathy (AT) and anterior cruciate ligament (ACL) ruptures. Variants within genes that encode proteoglycans such as *ACAN* (rs235191, rs1042630 and rs1516797), *BGN* (rs1126499, rs1042103) and *DCN* (rs516115) have previously been associated with susceptibility to ACL ruptures[1]. The functional significance of these loci are unknown. The aim of this study was to refine the disease susceptibility loci for MSK injuries by genotyping *ACAN*, *BGN* and *DCN* gene variants identified through whole exome sequencing (WES) of exemplar cases (clinically diagnosed with AT) and controls (unaffected).

Methods: The WES approach identified 56 variants within the *ACAN*, *BGN* and *DCN* genes. The following loci were prioritised and subsequently genotyped: *ACAN* (rs34949187, rs2351491, rs1042630, rs1042631, rs1516797, rs1126823), *BGN* (rs1126499, rs1042103, rs111325687) and *DCN* (rs7441, rs516115) in a South African and British cohort. The South African cohort comprised of 112 patients with AT and 120 asymptomatic, matched controls. The genotype and allele frequency distributions were evaluated using the R programming language and environment. Statistical significance was accepted at $p<0.05$.

Results: Preliminary investigations indicate a significant difference in the genotype and allele frequency distribution between cases and controls for the *ACAN* rs1516797 variant. The TT genotype was over-represented in the controls compared to the AT group (CON: 58.2%; AT: 38.1%; p=0.038; OR=0.649; 95%CI 0.21 to 2.04). No other differences between cases and controls in genotype or allele frequencies were identified for the variants genotyped.

Discussion: Further evaluation and interrogation of variants identified through the WES approach is still underway in an attempt to understand the genetic factors underpinning AT susceptibility which potentially maps to these proteoglycan encoding genes.

References:
1. Mannion S, Mtintsilana A, Posthumus M, et al. 2014. Genes encoding proteoglycans are associated with the risk of anterior cruciate ligament ruptures.Br. J. Sports Med. 48(22):1640–6

P30: Pieces to the puzzle: Identifying variants associated with musculoskeletal soft tissue injuries using whole exome sequencing

A Gibbon A[1], CJ Saunders[2], J Gamieldien[2], M Collins M[1], AV September[1]
[1]Division of Exercise Science and Sports Medicine, Department of Human Biology, University of Cape Town, Cape Town, South Africa; [2]South African National Bioinformatics Institute/MRC Unit for Bioinformatics Capacity Development, University of the Western Cape, Belville, Cape Town, South Africa
Presenting author Email address: *colljsaunders@gmail.com*

Introduction: DNA sequence variants have been associated with the risk of musculoskeletal soft tissue injuries, implicating the role of genetics in the aetiology of common sporting injuries including Achilles tendinopathy and anterior cruciate ligament ruptures. Risk conferring variants have primarily been identified using a hypothesis driven candidate gene approach. This approach, using a *priori* hypothesis of a gene's products involvement in injury, has implicated several biological pathways in disease development. However, it is not plausible to independently characterise all risk conferring variants in injury development using this method. Therefore, this study aimed to further define the genetic signature of musculoskeletal soft tissue injuries mapping to established biological pathways by utilizing next generation sequencing technologies and a host of bioinformatics tools.

Material and Methods: Whole exome sequencing (WES) was conducted on 10 cases and 10 controls representing divergent extremes of the injury spectrum. Cases were <35 years of age, suffered bilateral tendinopathy of the midportion and/or reported several chronic Achilles tendon injuries. Controls were >47 years of age, physically active and reported no previous injuries. Paired end WES, with the inclusion of the untranslated regions and miRNA genes, was performed using the Agilent V5+UTR (71Mbp) capture kit on the Illumina HiSeq 2000/2500 platform at 30X coverage.

Results: Preliminary results indicate the presence of 3016 variants mapping across the exome with allele frequency differences of ≥30% between cases and controls. Signals of particular interest include the matrix metalloprotease *(MMP*) gene cluster on chromosome 11q22 in addition to the regions spanning the tenascin-C (*TNC*) and the alpha 1 chain of type I (*COL1A1*) and type XXVII (*COL27A1*) collagen genes respectively.

Conclusion: Through this multidisciplinary approach, these signals of interest are being explored using a case-control genetic association design in larger cohorts and may provide valuable knowledge into the aetiology of musculoskeletal soft tissue injuries.

P31: TGF-β stimulated *BGN* gene expression in a genetic susceptibility model for musculoskeletal soft tissue injuries: A pilot *ex vivo* study.

M-J Laguette[1], L Alves de Souza Rios[1], K Willard[1], M Collins[1] and AV September[1].
[1]Division of Exercise Science and Sport Medicine, University of Cape Town, Cape Town, South Africa.
Presenting Author E-mail address: *nancylaguette@gmail.com*

Introduction: Variants in several genes, including proteoglycan encoding genes such as biglycan (*BGN*), have been implicated in modulating the risk of musculoskeletal soft tissue injuries. Biglycan is involved in fibrillogenesis, tendon development and healing. TGF-β is a mediator of the matrix remodelling pathway and, as observed in the context of injury and healing, is able to regulate *BGN* expression. Variants within *BGN* associate with anterior cruciate ligament ruptures (rs1126499, C/T and rs1042103, A/G) and with carpal tunnel syndrome (rs1126499). The primary aim of this study was to examine the relative *BGN* mRNA expression, in skin fibroblasts of healthy individuals with a known *BGN* genotype. Specifically, the effect of *BGN* rs1042103 (A/G) and rs1126499 (C/T) on its mRNA expression was examined (a) at baseline (N=10) and (b) in response to TGF-β1 treatment (N=4).

Methods: Participants were grouped according to their genotypes forming an increased (TT/AA and TT/AG at rs1126499/rs1042103 respectively, N=7) and a decreased risk group (CC/GG and CC/AA at rs1126499/rs1042103 respectively, N=3). Skin biopsies were obtained from consenting healthy participants with a known genotype at the loci of interest. Primary skin fibroblast cell lines were obtained. Cells were treated with 10ng/mL of purified TGF-β1. Total mRNA was extracted, cDNA was generated and Q-RT-PCR was performed. Relative expression of the target genes were compared between risk groups.

Results: *BGN* mRNA expression was not statistically different between the increased (CC/GG and CC/AA) and decreased risk (CC/GG and CC/AA) groups (p=0.84) at baseline. TGF-β1 treatment resulted in elevated expression of *BGN* in both groups with a higher expression observed in the decreased risk (CC/GG and CC/AA) group (2.40 ± 0.67; N=11) compared to the increased risk (TT/AA and TT/AG) group (1.47 ± 0.74; N=6) (p=0.024).

Discussion: Expression of *BGN* mRNA at baseline did not differ between genotype groups. However, when treated with TGF-β1, *BGN* mRNA levels were higher in the decreased risk group. The latter may be more readily able to enter processes such as healing and fibrillogenesis given the greater response to TGF-β1 w.r.t. *BGN* expression. This study highlights the possible effect of genetic variations on gene expression.

P32: More Tendinopathy than Inflammatory Arthritis in a New Patient Rheumatology clinic. A retrospective review of 397 new patients

P Kirwan[1,2], HP French[2], T Duffy[3]
[1]Physiotherapy Department, Connolly Hospital, Blanchardstown, Dublin 15, [2]School of Physiotherapy, Royal College of Surgeons in Ireland, Dublin 2 [3]Rheumatology Department, Connolly Hospital, Blanchardstown, Dublin 15
Presenting Author E-mail address: *paulkirwan@rcsi.ie*

Introduction: Tendinopathy is a common musculoskeletal complaint. A Recent Dutch[1] study has indicated that lower limb tendinopathy has a higher incidence (10.52 per person-years) than osteoarthritis (8.4 per 1000 person-years). The purpose of this review was to establish the number of patients with tendinopathy/tendon pain presenting to a general 'New Patient' rheumatology clinic.

Methods: Data were collected consecutively on all patients assessed by one experienced Physiotherapist working in the 'New Patient' rheumatology clinic from Dec 2010 to May 2016. No triage of these patients was performed, therefore Doctors and Physiotherapist see similar patients. A retrospective review of the data collected and medical charts was undertaken. The number of patients diagnosed with tendinopathy by the Physiotherapist was noted, and descriptive statistical analysis was undertaken. The diagnosis of tendinopathy was made clinically.

Results: In total, 392 patients were assessed over the time period, 265 females and 127 males, representing a 2:1 ratio for females to males. The mean age was 49 ± 13.7 years. Tendinopathy was diagnosed in 134 patients, therefore ***34% of all the patients assessed had tendon pain***. Thirty-two patients, 8% of the total, had bilateral tendon pain. The total number of painful tendons was 166.
The most common tendinopathy was rotator cuff tendinopathy accounting for 12% of patients (n=46), followed by gluteal tendinopathy representing 10% (n=38), whilst lateral elbow tendinopathy accounted for 9% of patients (n=31). Medial elbow, tibialis posterior, proximal hamstring, peroneal, patellar and Achilles tendinopathy accounted for the remaining 19 patients with tendinopathy. Plantar fasciopathy was diagnosed in 7% of patients (n=27). An *Inflammatory arthritis was diagnosed in 20% of patients (n=78)*.

Discussion: Results show that there is more tendinopathy than inflammatory arthritis in a 'New Patient' rheumatology clinic. Tendon pain combined with plantar fascia pain (41%), accounts for double the number of patients seen who were diagnosed with inflammatory arthritis.
This review reveals the high proportion of those presenting to a 'New Patient' rheumatology clinic have clinically diagnosed tendinopathy. It highlights the importance of knowledge of differential

diagnosis and evidence- based management of tendinopathy for doctors and other healthcare professionals working in rheumatology.

References:

1. Albers et al. BMC Musculoskeletal Disorders (2016) 17:16

P33: Plantaris tendon, its presence, location and size in the region of the Achilles tendon: An observational cadaveric study

P Kirwan[1,2], HP French[2]
[1]Physiotherapy Department, Connolly Hospital, Blanchardstown, Dublin 15, [2]School of Physiotherapy, Royal College of Surgeons in Ireland, Dublin 2
***Presenting Author E-mail address**: paulkirwan@rcsi.ie*

Introduction: The Plantaris tendon, which has long been disregarded as of little clinical importance, and absent in 7-20% of the population[1], is attracting some interest of late. Recently published studies indicate it is present in 98-100% of the population[2] and that it may act as a potential contributor to medial Achilles Tendon (AT) pain.
The aims of this study were threefold, to establish whether Plantaris was present in a sample of cadaveric limbs, to identify its position in relation to the Achilles tendon and to conduct measures of thickness and width of Plantaris tendon.

Methods: The method previously described by Van Sterkenberg et al[2] was employed to identify the Plantaris tendon. Eighty-one cadaveric limbs, which had been previously dissected and were appropriate for inspection were assessed. Plantaris was looked for in the region of the medial Achilles. If Plantaris could not be identified here, Gastrocnemius was reflected back to reveal Plantaris tendon beneath, and was then followed distally. All Plantaris tendon measurements were taken 2-6 cm from the Achilles insertion using a vernier caliper.

Results: The Plantaris tendon was present in all 81 assessed limbs. Plantaris was positioned medial to the Achilles tendon in all limbs. This medial position was then further subcategorized into medial or ventromedial. Plantaris tendon was positioned ventromedial to the Achilles tendon in 59 (73%) of the limbs and medial to the Achilles in 18 (22%) of the limbs. The mean width of the plantaris tendon was 2.8mm (range 1.2-5.0mm) and the mean thickness of the plantaris tendon was 0.8mm (range 0.1-1.6mm).

Discussion: Plantaris was present in all limbs in keeping with recent studies. The measures of Plantaris tendon width and thickness from this study found results similar to a recent cadaveric study[3]. Plantaris has been estimated by experts to be implicated in 20% of AT presentations, in particular those with medial Achilles pain. This study found that 22% of plantaris tendons were located medial to the AT, and this raises a question, whether a medially located plantaris has a greater potential to contribute to medial Achilles Tendon (AT) pain compared to VM positioned plantaris tendons?

References
1. Van Sterkenberg and van Dijk. Knee Surg Sports Traumatol Arthrosc 2011;19:1367-1375
2. Van Sterkenberg et al. J Anat. 2011;218(3):336-41
3. Olewnik et al. Surg Radiol Anat. 2016

P34: Plant derived rhCollagen scaffold combined with PRP enhances healing in tendinopathy

O Shoseyov[1,2], J Seror[1], R Gueta[3], F Grynspan[4], T Amzel[1,] A Nyska[5], N Orr[1].
[1]CollPlant Ltd., Ness-Ziona, Israel. [2]The Robert H. Smith Faculty of Agricultural, Food and Environmental Quality Sciences, The Hebrew University of Jerusalem, Rehovot, Israel. [3]Amorphical, Ness-Ziona, Israel. [4]Stem Cell Medicine Ltd, Jerusalem, Israel. [5]Sackler School of Medicine, Tel Aviv University, Israel, and consultant in Toxicologic Pathology
***Presenting Author E-mail address**: Nadav@collplant.com*

Introduction: Vergenix™STR is a novel medical device scaffold composed of recombinant human Type I Collagen (rhCollagen) purified from bioengineered tobacco plants harboring the 5 human genes essential for the production of genuine human Type I collagen(1). Vergenix™STR combined

with autologous Platelets Rich Plasma (PRP) was developed to address the limitations of PRP treatment by providing a degradable matrix that retains the platelets at the vicinity of the injured tendon and extends the effect of growth factorsthus promotes healing. The device is intended for the treatment of tendinopathy.

Methods: Preparation of product: Vergenix™STR is provided lyophilized and terminally sterilized by EtO. The dry product is hydrated with autologous PRP before injection into the injury site,
Preclinical evaluation: The product performance was assessed in a rat model for tendonitis and in a subcutaneous rat model of local growth factors release and degradation profile.
Clinical trial: A multicenter, prospective, open label, single arm trial was conducted to demonstrate the safety and performance of the product in 20 patients suffering from epicondylitis (tennis elbow). Patients were followed for six months after a single injection while product performance was assessed by reduction in pain and recovery of motion using the standard Patient Related Tennis Elbow Evaluation questionnaire ("PRTEE").

Results: The subcutaneous rat model showed a significant extended release of PDGF and VEGF in the product group as compared with PRP alone. Tendonitis model in rats showed clear advantage of the product as compared to PRP alone. In the clinical trial, the new product provided clear clinical benefit to the patients with 80% and 90% of the patients showing at least 25% reduction in PRTEE score after 3 and 6 months respectively. These results are significantly better than results reported(2) for either PRP alone or corticosteroids which had up to 68% (PRP, 6 months) or 48% (corticosteroids, 3 months) of patients reporting at least 25% reduction in pain and motion score.

Conclusions: Vergenix™STR combined with PRP showed superior performance compared with PRP alone in preclinical models and clinical setups. The results provide clear evidence supporting the use of Vergenix™STR combined with PRP for treatment of tendinopathy.

References
1. Stein H et al., Biomacromolecules 2009 10(9) 2640
2. Peerbooms et al, Am J Sports Medicine 2010 38(2) 255

P35: Non-rigid speckle tracking exploratory study for tendinopathy signaling in symptomatic subjects

C Carvalho[1], S Bogaerts[2], L Scheys[3], J D'hooge[4], K Peers[2], F Maes[1], P Suetens[1]
[1]KU Leuven, ESAT/PSI & UZ Leuven, MIRC iMinds, Medical IT Dept, KU Leuven, and UZ Leuven, [2]Dept. of Development and Regeneration, [3] Dept. of Orthopedics, [4]Dept. of Cardiovascular Sciences
***Presenting Author E-mail address**: stijn_bogaerts@hotmail.com or stijn.1.bogaerts@uzleuven.be*

Introduction: Tendinopathies are one of the most common musculoskeletal injuries affecting both professional and recreational athletes. Knowledge on tendon biomechanics is scarce and limited to some studies regarding global strain and local tissue deformation estimates in healthy subjects [1,2]. The objective of this study was therefore to investigate differences in the biomechanical behavior at the level of local tissue deformation between asymptomatic and symptomatic subjects.

Methods: High-frequency dynamic (2D+t) US data of both Achilles tendons of 10 asymptomatic subjects and of the symptomatic Achilles tendon of 8 subjects were acquired. Symptomatic subjects were classified based on clinical interpretation of symptoms and morphological appearance on US in three groups: less severe (C1), medium severe (C2) and very severe (C3) tendinopathy.
A non-rigid speckle tracking method was applied to each 2D+t US images, yielding the tissue deformation along the major deformation direction in each tendon voxel. Four sub-regions were defined within the tendon, corresponding to proximal/distal and superficial/deep tendon regions.
Mean deformation for each subject was evaluated by averaging the deformation of the 4 sub-regions at the maximum isometric contraction point. Comparison between symptomatic and asymptomatic group (C2+C3) was evaluated using a two-tailed homoscedastic t-test and a ROC analysis was also

performed between the two groups.

Results: No significantly differences (p=0.06) were found between asymptomatic (n=20) and symptomatic (n=10) subjects. However, when comparing more severe symptomatic cases (C2+C3, n=7) with asymptomatic subjects, significant differences (p=0.02) were found. ROC analysis between asymptomatic and more severe symptomatic cases (C2+C3) returned an area under the ROC curve (AUC) of 0.83.

Discussion: We show here, for the first time, preliminary results that allow the local biomechanical discrimination between more severe tendinopathy cases and asymptomatic cases. Due to the small size of the datasets, more symptomatic images should be further acquired. Further investigation should also be done for symptomatic subjects within C1 since these subjects present tissue deformation values close to the ones presented by asymptomatic subjects. This close range of deformation values may then be the reason for the non-significant difference found between asymptomatic and symptomatic cases.

References:
1. Arndt A, Bengtsson A-S, Peolsson M, Thorstensson A, Movin T. Non-uniform displacement within the Achilles tendon during passive ankle joint motion. Knee surgery, Sport Traumatol Arthrosc. 2012;20:1868–74.
2. Slane LC, Thelen DG. Achilles tendon displacement patterns during passive stretch and eccentric loading are altered in middle-aged adults. Med Eng Phys. 2015;37(7):712–6.

P36: Cross-sectional pilot study comparing function, morphology and biomechanical behavior of conservatively versus surgically treated Achilles tendon ruptures.

S Bogaerts[1], E Smeets[2], B Trenson[1], K Peers[1]
[1] Department of Physical Medicine & Rehabilitation, University Hospitals Leuven, Belgium [2] Master student, Faculty of Medicine, KU Leuven, Belgium
***Presenting Author E-mail address**: stijn_bogaerts@hotmail.com or stijn.1.bogaerts@uzleuven.be*

Introduction: Surgical treatment has been the treatment of choice in Achilles tendon rupture (ATR), but recent studies of conservative treatment have shown similar results with fewer complications. However, little is known about the difference in biomechanical behavior of the tendon after operative versus non-operative treatment. The goal of this study was to compare surgically versus conservatively treated Achilles tendons ruptures, including an ultrasound-based assessment of regional mechanical tendon behavior.

Methods: Patient related outcome measures were assessed using questionnaires (Victorian Institute of Sports Assessment – Achilles, Achilles Tendon Rupture Score). Functional evaluation was done using isokinetic plantar flexor strength on a Biodex machine at 60°/sec and establishing the limb symmetry index (LSI), a heel rise endurance test, using the contralateral healthy leg as control. Structural and mechanical properties were evaluated with 3D free hand ultrasound, measuring Achilles tendon length from gastrocnemius muscle-tendon junction to calcaneal insertion at different ankle angles, and global strain, being the relative elongation from maximal dorsi- to plantar flexion.

Results: There were 3 surgically (2 male, 1 female) and 3 conservatively (2 male, 1 female) treated patients included. Mean age overall was 52.8 years (SD = 9.79) with an average time from ATR until testing of 10.8 months (SD = 1.47).
Preliminary results show a mean score of 84.00 (SD = 1) for ATRS and 84.33 (SD = 16.86) for the VISA-A score in the conservatively treated group, compared to 78.0 (SD = 24) and 78.5 (SD = 12.02) in the surgically treated group. Isokinetic strength ranged from 13.8 to 144.3 N/kg in both groups combined. The mean LSI for endurance testing was 60 (SD = 7.07) for the conservative group and 70.45 (SD = 26.09) for the surgical group. Range of motion in dorsiflexion was consistently higher in

the treated leg in all subjects. Tendon length and global strain were similar between groups. Overall, there were no statistically significant differences between groups.

Conclusion: These preliminary results are in line with those in literature, where symptoms and functional outcome after tendon rupture is similar for conservative versus operative treatment including mechanical tendon behavior. The comparable strain results in the conservative group justify further investigation on a larger group to increase the power of this biomechanical analysis of ATR. Given the higher risk of complications with surgery, this may provide further evidence that Achilles tendon ruptures can be treated conservatively.

P37: Modulation on tendon vascularization is associated with pain in athletes with patella tendinopathy after 12-week of eccentric exercise combined with extracorporeal shockwave therapy

WC Lee[1], ZJ Zhang[2], L Masci[3], GYF Ng[1], SN Fu[1],

[1]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong (SAR), China, [2]Department of Physical Therapy, Henan Provincial Orthopaedics Hospital, Henan, China, [3]Pure Sports Medicine, London, United Kingdom

***Presenting Author E-mail address**: amy.fu@polyu.edu.hk*

Introduction: Decrease in tendon vascularization was observed in subjects being successfully treated with exercise[1] and extracorporeal shockwave therapy (ESWT)[2]. It is unclear whether combining both interventions would enhance the treatment-induced effect.

Methods: Thirty-three male basketball, volleyball, and handball players (mean age=22.8±4.0 years) with patellar tendinopathy for more than 3 months (mean 33.0±26.3 months) participated in the study. Subjects were randomized into Exercise and Combined groups. The exercise group received a 12-week single-legged decline-squat exercise and the combined group had a similar exercise programme in addition to 6 weekly sessions of Extracorporeal shockwave therapy (ESWT) in the initial 6 weeks of the exercise programme. Tendon vascularization of the patellar tendon was examined using Power Doppler Ultrasonography. The intensity of vascularization determined by the percentage of colour pixels was expressed as vascular index (VI). The intensity of maximal self-perceived pain on past 7 days was enquired using visual analogue scale (VAS). These parameters were measured at pre, post intervention and 6-week post intervention.

Results: Twenty-nine subjects completed the programme. Repeated measures ANOVA on tendon VI indicated significant time effect (p=0.024), significant main effect on pre-intervention VI (p=0.000) and time* pre-intervention VI interaction (p=0.004) on the changes of tendon vascularity. No significant group effect was detected (p=0.471). There was a significant reduction of the intensity of pain from (from 6.4±2.0 to 2.6±1.6, p=0.000) at 6-week post intervention. Partial correlation test was conducted with pre-intervention VI and side of affected knee as control variables. Significant correlation was detected between the change in tendon VI and the reduction in pain at post-intervention (r=-0.70, p=0.017) and 6-week post-intervention (r=-0.83, p=0.001) in the combined group.

Discussion: Modulation on tendon vascularity depends on pre-intervention vascularization. Addition of ESWT could not enhance the change of tendon vascularity and pain. The reduction in tendon vascularity, however, is related to the reduction in pain in the combined group. Our findings support the notion that reduction in tendon vascularization is one of the treatment mechanisms for subjects receiving ESWT and eccentric exercise.

References:

1. Kongsgaard M, Kovanen V, Aagaard P, Doessing S, Hansen P, Laursen AH, Kaldau NC, Kjaer M, Magnusson SP. Corticosteroid injections, eccentric decline squat training and heavy slow resistance training in patellar tendinopathy. Scand J Med Sci Sports 2009. 19(6):790-802.

2. Notarnicola A, Moretti L, Tafuri S, Forcignano M, Pesce V, Moretti B. Reduced local perfusion after shock wave treatment of rotator cuff tendinopathy. *Ultrasound Med Biol*. 2011;37(3):417-425.

P38: A preliminary exploration of somatosensory and psychological characteristics in a severe subgroup of individuals with lateral epicondylalgia

V Vuvan[1]; R Mellor[1]; L Heales[3]; B Coombes[1]; P Hodges[1]; M Farrell[2]; and B Vicenzino[1]
[1]School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Australia, [2]School of Biomedical Sciences, Monash University, Clayton, Australia, [3]School of Human, Health and Social Science, Division of Physiotherapy, Central Queensland University, Rockhampton, Australia
***Presenting Author E-mail address**: v.vuvan@uq.edu.au*

Introduction: One of the challenges in the management of lateral epicondylalgia (LE) is the varying prognoses of individual patients. Previous post-hoc analyses of clinical trials indicate that there might be a characteristic somatosensory profile that identifies a severe subgroup and predicts those with a poor outcome. The aim of this study was to investigate the somatosensory and psychological characteristics that might characterise LE subgroups on the basis of their severity of pain and disability as scored by the Patient Rated Tennis Elbow Evaluation (PRTEE).

Methods: Forty-six participants (mean age 46 years, 23% female) with a primary clinical diagnosis of LE were sub-grouped into mild (23), moderate (17) and severe (5) on the basis of a previous cluster analysis using the PRTEE. Thirteen healthy controls (mean age 48 years, 39% female) also participated. Thermal and mechanical detection and pain thresholds, vibration threshold, and pain sensitivity to sharp and blunt mechanical stimuli were evaluated at the lateral epicondyle and infrapatellar pole. Temporal summation of heat pain was measured at the hand. The PainDETECT, Neck Disability Index, Health-related Quality of Life, Hospital Anxiety and Depression Scale, Tampa Scale of Kinesiophobia, Pain Catastrophising Scale and Pain Self Efficacy Questionnaire were also collected.

Results: The severe LE subgroup showed lower mechanical detection threshold at the elbow compared to healthy controls ($p<0.05$). Increased temporal summation of heat pain and PainDETECT scores were found in the severe LE subgroup compared to the mild LE subgroup ($p<0.01$).

Discussion: Findings from this preliminary study suggest that individuals with severe LE might be differentiated by increased sensitivity to light touch at the elbow and enhanced temporal summation. Whilst a lower PainDETECT score (≤12) suggests nociceptive pain may be the main mechanism in individuals with mild LE, the results for individuals with severe LE are unclear, however infer a component of neuropathic pain (PainDETECT score 13-18) might be present within this subgroup.

P39: Patient characteristics associated with the severity of pain and disability of gluteal tendinopathy

ML Plinsinga[1]; BK Coombes[2]; R Mellor[1]; P Nicolson[5]; A Grimaldi[3]; J Wajswelner[4]; P Hodges[1]; K Bennell[5]; and B Vicenzino[1]
[1]University of Queensland, School of Health and Rehabilitation Sciences: Physiotherapy, University of Queensland, St Lucia, Brisbane, Australia, [2]University of Queensland, School of Biomedical Sciences, St Lucia, Brisbane, Australia, [3]Physiotec, 23 Weller Road, Tarragindi, Qld 412, Australia, [4]Department of Physiotherapy & Lifecare Physiotherapy, LaTrobe University, Bundoora, Australia, [5]Centre for Health, Exercise and Sports Medicine, Department of Physiotherapy, University of Melbourne, Carlton, Australia
***Presenting Author E-mail address**: m.plinsinga@uq.edu.au*

Introduction: Gluteal tendinopathy is a prevalent condition among middle-aged females, impacting on daily activities, work and quality of life. The primary aim was to describe a broad range of physical

and psychological health characteristics of patients with gluteal tendinopathy and to determine relationships with severity of pain and disability.

Methods: 203 participants (mean age 54.8 years, range 35-71, 82% female) meeting a clinical diagnosis of gluteal tendinopathy with MRI confirmation were included in this study. 77% had unilateral pain, and 23% bilateral. Measures were anthropometric (BMI, waist girth, hip circumference, waist-hip ratio (WHR)), physical (hip abductor muscle strength) and questionnaires (VISA-G, Active Australia Survey, Pain Catastrophizing Scale (PCS), the Pain Self-Efficacy Questionnaire (PSEQ), Health-related Quality of Life (EQ-5D)). Cluster analysis of the VISA-G scores (range 0-100, 100=no pain and disability) classified participants into mild, moderate and severe pain and disability. An ANCOVA was performed to evaluate whether characteristics differed between subgroups based on severity, including sex as a covariate, followed by Bonferroni post-hoc tests. Significance was set at 0.01.

Results: Cluster analysis of the VISA-G identified three subgroups: mild (n=51; mean 76.5; range 68-98), moderate (n=103; mean 59.0; range 51-67) and severe (n=49; mean 42.7; range 14-50), supported by a corresponding and incrementally greater average/worst pain ($p \leq 0.001$). Pain catastrophizing scores and pain self-efficacy scores were significantly different between groups ($p<0.001$), post hoc analysis revealed greater pain catastrophizing and a lower pain self-efficacy in the moderate and severe groups than the mild group. Higher scores on vigorous activity (MD 131.82 minutes; 95%CI 32.38, 231.26; $p=0.005$) and quality of life (MD 0.123; 95%CI 0.047, -.198; $p<0.001$) were reported for the mild group than the severe group. Hip abductor muscle strength, waist girth and WHR differed between sexes ($p<0.001$) but not sub-groups differences; values for these parameters were greater for men than women.

Discussion: Individuals with greater severity of pain and disability accompanying their gluteal tendinopathy present with lower pain self-efficacy, higher pain catastrophizing, lower vigorous activity levels, and lower quality of life than those with less severe symptoms. Future research would benefit from consideration of both psychological and physical assessments and interventions.

P40: Increase in tendon strain is associated with pain reduction after 12-week eccentric exercises in jumping athletes with patella tendinopathy

SN Fu[1], WC Lee[1], ZJ Zhang[2], L Masci[3], GYF Ng[1]
[1]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong (SAR), China, [2]Department of Physical Therapy, Henan Provincial Orthopaedics Hospital, Henan, China, [3]Pure Sports Medicine, London, United Kingdom
***Presenting Author E-mail address**: amy.fu@polyu.edu.hk*

Introduction: Strength training that induces mechanical loading on the tendon and alters its mechanical properties. These changes have been reported in healthy[1] but scarce information is on pathologic tendons. Whether a change in tendon mechanical properties would relate to reduction in pain is not known.

Methods: Thirty-five male basketball, volleyball and handball players (mean age=22.4±4.0 years, 16 had unilateral symptoms) with tendinopathy for more than 3 months (mean 31.9±25.4 months) participated in the study. Subjects were randomized into Exercise and Combined groups. The exercise group received a 12-week single-legged decline-squat exercise and the combined group had a similar exercise programme in addition to 6 weekly sessions of Extracorporeal shockwave therapy (ESWT) in the initial 6 weeks of the exercise programme. Tendon strain of the patellar tendon was examined using ultrasonography and dynamometry. The intensity of maximal self-perceived pain over 7 days was enquired using visual analogue scale (VAS). These parameters were measured at pre- and post- intervention.

Results: Thirty-one subjects (15 with unilateral symptom) completed the treatment programme. Repeated measures ANOVA indicated significant time effect (all $p<0.05$) but not significant group effect (all $p>0.05$) on the outcome measures. Significant increase in tendon strain (from 10.5±4.1% to

13.1±5.3%, p=0.08), and reduction of intensity of pain (from 6.5±2.0 to 3.5±2.1, p=0.00) were observed at post-intervention. Partial correlation test was conducted with sports and side of affected knee as control variables. A significant correlation was detected between the reduction in perceived pain and the increase of tendon strain (r=0.82, p=0.003) in the exercise group. No significant correlation was found in the combined group.

Discussion: 12-week of eccentric exercise induced increase of tendon strain in athletes with patellar tendinopathy. The increase in tendon strain is related to the reduction in pain. Our findings suggest that eccentric exercise programme could modulate tendon mechanical properties and such change is associated with the reduction of pain in athletes with patellar tendinopathy.

References:
1. Reeves ND, Maganaris CN, Narici MV. Effect of strength training on human patella tendon mechanical properties of older individuals. J Physiol 2003;548:971-81.
2. Kubo K, Kanehisa H, Fukunaga T. Effects of different duration isometric contractions on tendon elasticity in human quadriceps muscles. The Journal of physiology 2001;536(Pt 2):649-655.

P41: Taping facilitates scapular kinematics and activity onset of scapular muscles in athletes with rotator cuff tendinopathy

HT Leong[1], GYF Ng[1], SN Fu[1]
[1]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong (SAR), China
***Presenting Author E-mail address**: annieleonght@gmail.com*

Introduction: Athletes with rotator cuff tendinopathy demonstrated abnormal scapular motion and activity onset of scapular muscles during arm elevation. The aim of this study is to examine the effect of scapular taping on the kinematics and activity onset of scapular muscles in athletes with rotator cuff tendinopathy.

Methods: Twenty-six male volleyball players with rotator cuff tendinopathy (mean age=23.6±3.3 years) participated in the study. Three-dimensional scapular kinematics was quantified using an acromial marker cluster method, and electromyography (EMG) activity onset of upper, middle and lower trapezius and serratus anterior during shoulder abduction were compared with three scapular taping protocols, namely, no taping, therapeutic taping, and placebo taping.[1]

Results: There were significant increases in scapular upward rotation from 0° to 30° (7.16±2.34° vs. 6.40±2.16°, p=0.007), and from 60° to maximum shoulder abduction (27.27±6.08° vs. 24.93±6.11°, p=0.019) when therapeutic taping and no taping conditions were compared. No significant effect of taping was found on posterior tilting (p=0.379) and external rotation (p=0.131). Placebo taping demonstrated no effect on any scapular motions (all p>0.263). The middle and lower trapezius, and serratus anterior fired earlier in both therapeutic taping (all p<0.005) and placebo taping conditions than no taping conditions (all p<0.002).

Discussion: Scapular taping modulates the scapular kinematics in athletes with rotator cuff tendinopathy by providing mechanical support and neuromotor facilitation of the scapular muscles during dynamic arm abduction. Scapular taping with full tension can effectively increase scapular upward rotation in the early phase of abduction from 0° to 30° and in the late phase from 60° to maximum abduction. Scapular taping with or without tension can hasten the activity onset of scapular muscles during dynamic arm abduction. Based on our findings, scapular taping with tension is suggested for athletes with rotator cuff tendinopathy to enhance the neuromotor control of the scapular muscles and to provide mechanical support for normal scapular kinematics during arm movement. .

References:
1. Cools AM, Witvrouw EE, Danneels LA, Cambier DC. Does taping influence electromyographic muscle activity in the scapular rotators in healthy shoulders? Man Ther 2002;7(3):154-162.