



*Towards healthy tendon ageing.....*

## **Program & Abstract Book**

Thursday, September 27, 2018

Friday, September 28, 2018

Saturday, September 29, 2018

[www.ists2018.com](http://www.ists2018.com)



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# Welcome by the Chair

Dear all,

It is a really great pleasure to welcome you, friends and colleagues, on behalf of the Local Organizing Committee in Groningen at the 5<sup>th</sup> International Scientific Tendinopathy Symposium (ISTS) 2018.

Based on the success of previous congresses in Umea, Vancouver, Oxford and Cape Town, which attracted a growing number of clinicians and researchers from scientific groups involved in tendon research from around the world, we feel honoured to be your host at this Fifth Anniversary Edition.

Just like in the previous congresses, the upcoming conference will present information on both relevant basic tendon scientific research and clinical evidence-based methods to prevent and manage tendon-related problems using a multidisciplinary perspective. The overarching theme 'Towards Healthy Tendon Ageing...' covers fundamental biological and clinical/preclinical research as well as applied research into the social and societal impact of tendinopathy. Invited keynote lecturers, 'What can we learn from...' discussions, free communications, poster presentations and workshops will be part of the programme.

The city of Groningen has been chosen to host the event, and the [University Medical Center Groningen \(UMCG\)](#) with its state-of-the-art conference facilities will serve as a perfect venue setting. Groningen is the largest city of the northeastern Netherlands. In this bustling university town everyone will find something of their liking. Next to its trademark Martini Tower and the eye-catching Groninger Museum, the city centre offers a wide variety of shops, bars and restaurants.

The scientific programme, the city, and last but not least the great opportunity to catch up and share knowledge with your international colleagues, are just some of the reasons why you should come to the 5th ISTS meeting in Groningen in 2018. If you are involved in tendon research you will not want to miss this unique opportunity and experience!

On behalf of the Organizing Team, I wish you a pleasant time with us in Groningen.

Hans Zwerver  
Chair



## Welcome by the Dean of the UMCG

A warm word of welcome to all participants of the 5th International Scientific Tendinopathy Symposium. We are most happy to cordially welcome everyone in Groningen!

This edition of the ISTS will focus on the topic: Towards healthy tendon ageing. This subject is a perfect fit with the overarching Groningen research theme of Healthy Ageing. Researchers from the University of Groningen and the University Medical Center Groningen (UMCG) have invested over a decade of research on healthy ageing, from a life course perspective. Healthy lifestyle, including sports and movement, is something of all ages; investments early in life impact positively on the ageing process. This goes hand in hand with other lifestyle ingredients, such as healthy food intake, a non-smoking policy and reduced alcohol intake especially in adolescents. In a joint effort, health organizations, academic partners, the city of Groningen and governmental bodies promote the awareness of healthy ageing among the citizens.

During the 5th ISTS, the importance of tendons and tendinopathies will be highlighted. The program offers a wide array of lectures, ranging from fundamental and clinical research to studies on the social and societal impact of movement and tendinopathies. This truly translational and multidisciplinary approach, from bench to bedside, is exemplary for most of the research lines in the UMCG. We aim to understand the mechanisms of diseases, to promote prevention and develop innovative treatments to help our patients, including those with a movement disorder.

On behalf of the UMCG, I wish the organizers of the 5th ISTS all the best for their endeavors and hope to see many participants in Groningen.

On behalf of the UMCG and University of Groningen,

Marian Joëls  
Dean of Medicine



## Local Organizing Committee & Scientific Committee

The Symposium is organized by the Departments of Sports Medicine, Orthopedics, Human Movement Sciences and Pathology & Medical Biology of the UMCG, the Dept. of Orthopedics of the Erasmus MC Rotterdam and the Hanze University of Applied Sciences Groningen and Centre of Expertise Primary Care Groningen (ECEZG) in cooperation with the Wenckebach Instituut of the UMCG.



**Hans Zwerver, MD, PhD**

Professor of Sport & Exercise Medicine, sports medicine physician, UMCG (chair)



**Inge van den Akker-Scheek, PhD**

Human movement scientist and epidemiologist, UMCG



**Mathijs van Ark, PhD**

Physiotherapist and human movement scientist Hanze University of Applied Sciences Groningen and Centre of Expertise Primary Care Groningen (Peescentrum ECEZG)



**Ruud Bank, PhD**

Professor in Matrix Biology & Tissue Repair, UMCG



**Ronald L. Diercks, MD, PhD**

Orthopedic surgeon, professor of Clinical Sports Medicine, UMCG



**Robert-Jan de Vos, MD, PhD**

Sports medicine physician, Erasmus MC University Medical Center, Rotterdam

## Keynote speakers



**Dr. Michele Abate, MD, PhD** is Specialist in Physical Medicine and Rehabilitation Department of Medicine and Science of Aging, University G. d'Annunzio, Chieti Scalo (CH), Italy.



**Prof. Michael Kjaer, MD, DMSc, PhD** was educated as a Medical doctor from University of Copenhagen, Denmark, in 1984 and became a Specialist in Rheumatology in 1995. He is Head of Institute of Sports Medicine, Dept of Orthopedic Surgery, Bispebjerg Hospital in Copenhagen and Clinical Professor in Sports Medicine at University of Copenhagen, Denmark. Dr. Kjaer's research group focuses on adaptation of tendon and skeletal muscle to mechanical loading and physical training, with special emphasis on physiological-pathological adaptation to overloading and regeneration of tissue. He has published more than 250 original papers and supervised more than 20 PhD students and 5 post doctoral students.



**Dr. Edwin Oei, MD, PhD** is a musculoskeletal radiologist, Associate Professor of musculoskeletal imaging, and Section Chief of musculoskeletal radiology in Erasmus MC's Department of Radiology, Rotterdam. He obtained his medical degree in 2004 and his PhD on MRI for traumatic knee injury in 2009, both from Erasmus University. He also holds an MSc in Clinical Epidemiology from the Netherlands Institute for Health Sciences. His residency in radiology was completed at Erasmus MC in 2009, followed by a fellowship in musculoskeletal radiology. Dr. Oei is the principal investigator of musculoskeletal imaging research and engages in many academic activities including supervising 8 PhD students, lecturing, board and committee memberships, and refereeing for various journals.



**Dr. Ebonie Rio, PhD** is a National Medical Research Centre post doctoral research fellow at La Trobe University, Sport and Exercise Medicine Centre. She completed her PhD in neuroscience and tendon pain, Masters Sports Phys, Ba. Phys (hons) and Ba. App Sci. Her research has been awarded Victorian Fresh Scientist of the year 2015, ASICS SMA Best New Investigator 2004, 2013 & 2014 in Clinical Sports Medicine, best clinical science Pain Adelaide 2013, BJSM young investigator Best Clinical Paper 2014 and the Professor Mollie Holman medal for the best thesis of the Faculty of Medicine, Nursing and Health Sciences Monash University 2015 and the ECR best paper 2015. Her clinical career has included Australian Institute of Sport, The Australian Ballet Company, Melbourne Heart football club,

Alphington Sports Medicine Centre, Victorian Institute of Sport, Commonwealth Games 2006, 2010 Vancouver Winter Olympics, 2010 Singapore Youth Olympics, 2012 London Paralympics, 18 months travelling with Disney's The Lion King stage show (Melbourne and Shanghai tour) and she was awarded the Post-Graduate Scholarship at the AIS (2007).



**Hazel Screen, CEng MIMechE MIPEM**, is Professor of Biomedical Engineering and Chair of the Division of Bioengineering at Queen Mary University of London. Her research centres on healthy and pathological tissue structure-function behaviour, with particular interests in tendon, ligament and cardiac tissues. She has published over 100 papers across the field of mechanobiology and biomechanics, and leads a major UK tendon consortium (<http://www.tendon.qmul.ac.uk>).

This highly multidisciplinary group carry out widely varying research, with activity in human and animal in vivo studies of tendon biomechanics and injury, in addition to a major drive in analysing tissue mechanics and cell mechanobiology from the nano- to macro scale.



# Guidelines Presentations

Below you can find guidelines for presenters of the free communications and/or poster pitches. All presenters are underlined (see Chapter 'Abstracts').

## Free Communications and Poster Pitch

- All presenters are requested to stay within the allotted time limits.
- The location for the presentations is the Main Lecture Hall 'Blauwe Zaal' ('Blue Room').
- PowerPoint 2010 and up will be acceptable (if different, please inform the LOC).
- Store the presentation on an USB and bring it on time to the Upload Desk.
- The Upload Desk is located next to the Registration Desk.
- Include the number and the presenter's name in the PowerPoint file name.
- We will handle all data responsibly and delete them after the symposium.
- We will not provide facilities to present from your own laptop.

### FREE COMMUNICATIONS

- A total number of 8 Free Communications Sessions (A-H) are scheduled:
- During a Free Communication Session 5 oral presentations are scheduled.
- Abstract numbers are: A1-A5; B6-B10; C11-C15; D16-D20; E21-E25; F26-F30; G31-G35; H36-H40.
- Each presentation is limited to 10 minutes presentation time, followed by 2 minutes discussion time.

### POSTER PITCH

- A total number of 4 Poster Pitch Sessions are scheduled.
- During a Poster Pitch Session 12 or 13 oral presentations are scheduled.
- Abstract numbers are: P1-P12; P13-P25; P26-P35; P36-P48.
- Each presentation is limited to 1 minute - 1 ppt-slide and without discussion time.

## Poster Sessions

- The panel size of the (brushed nylon) poster board is 100 cm wide and 120 cm high. Please choose the sizes of your poster to fit into this format, so it can be mounted on the board without hampering the posters of your neighbors. Material to mount the posters are available at the registration desk.
- The presenter is invited to be near his/her board at least at the designated poster sessions.
- Posters should be shown during all three days of the symposium.
- Please mount your poster on the board preferably before the program starts on Thursday between 08.00-09.00 hr. and no later than 15 minutes before the start of the symposium.
- The posters should be removed at the end of the last day after the last poster session. Posters not removed at the end of the symposium will be removed by the organizers.
- Poster numbers are: P1-P85.



# Awards

At the Closing Session on Saturday two Awards will be given.

1. One award for the best Oral Presentation.
2. One award for the best Poster.

The selection will be done by an outstanding jury:

- Inge van den Akker-Scheek (PhD): member of the Local Organizing Committee ISTS 2018.
- Robert-Jan de Vos (MD PhD): member of the Local Organizing Committee ISTS 2018.
- Chairs and/or members of Scientific Committees from previous editions ISTS.

# Scientific Program

**THURSDAY, SEPTEMBER 27, 2018**

08.00 Registration with Coffee in the UMCG  
Upload Desk open  
Mounting Posters

09.00 Welcome  
**Prof.dr. Hans Zwerver, chair ISTS 2018**  
**Prof.dr. Marian Joëls, Dean of Medicine UMCG**

## **Session Tendon Ageing**

**Chairs: Prof.dr. Ruud Bank & Prof.dr. Kirsten Legerlotz**

09.30 Keynote 1 - Tendon ageing and the Interfascicular Matrix Niche  
**Prof. Hazel Screen, United Kingdom**

10.00 Free communication session A1-A5  
**A1: ACTIVITY INDUCED INCREASE IN ACHILLES TENDON BLOOD FLOW IS AGE AND GENDER DEPENDENT**  
EW Wezenbeek, DDC De Clercq, NM Mahieu, TW Willems, EW Witvrouw  
Ghent University, GHENT, Belgium

**A2: INTRINSIC RECOVERY MECHANISMS IN RAT TAIL TENDON, THEIR LIMITATIONS AND THOSE OF THE MODEL SYSTEM.**  
TS Stauber, JGS Snedeker, SLW Wunderli  
ETH Zurich, Balgrist Campus, ZURICH, Switzerland

**A3: LIFE-LONG HABITUAL SIDE-SPECIFIC LOADING IS ASSOCIATED WITH REDUCED MECHANICAL STRESS IN THE OLDER PATELLAR TENDON**  
C. Couppe<sup>1</sup>, RB. Svensson<sup>1</sup>, SV. Skovlund<sup>1</sup>, JK. Jensen<sup>1</sup>, J. Damm Nybing<sup>2</sup>, M. Kjaer<sup>1</sup>, SP. Magnusson<sup>1</sup>  
<sup>1</sup>Institute of Sports Medicine - IOC Research Center, Bispebjerg Hospital, COPENHAGEN NV, Denmark  
<sup>2</sup>Department of Radiology, Bispebjerg Hospital, COPENHAGEN NV, Denmark

**A4: DISORGANIZED MATRIX TOPOGRAPHY AND MECHANICAL LOAD MEDIATE MACROPHAGE INFLAMMATORY RESPONSE IN A TENDINOPATHY MODEL**  
AD Schoenenberger<sup>1</sup>, U Silvan<sup>2</sup>, SF Fucentese<sup>3</sup>, J Widmer<sup>2</sup>, K Maniura-Weber<sup>4</sup>, JG Snedeker<sup>2</sup>  
<sup>1</sup>University Hospital Balgrist/ETH Zurich, ZURICH, Switzerland  
<sup>2</sup>University Hospital Balgrist/ ETH Zurich, ZURICH, Switzerland  
<sup>3</sup>University Hospital Balgrist, ZURICH, Switzerland  
<sup>4</sup>EMPA, ST. GALLEN, Switzerland

**A5: IDENTIFICATION OF SUSCEPTIBILITY LOCI FOR MUSCULOSKELETAL SOFT TISSUE INJURIES USING A BIOLOGICAL NETWORK MAPPING STRATEGY**  
SB Dlamini<sup>1</sup>, CJ Saunders<sup>1</sup>, J Gamielien<sup>2</sup>, AP Gibbon<sup>1</sup>, M Collins<sup>1</sup>, AV September<sup>1</sup>  
<sup>1</sup>University of Cape Town, CAPE TOWN, South Africa  
<sup>2</sup>South African National Bioinformatics Institute, CAPE TOWN, South Africa

## Poster Pitch P1-P12

**P1: PHOTOBIOIMODULATION ON EARLY PHASE OF TENDON RUPTURE REHABILITATION: CASE SERIES**

Carlos E Pinfieldi, Pedro Rizzi de Oliveira, Mariana Ventura, Lucas Simões Arrebola  
University Federal of São Paulo - UNIFESP, SANTOS, Brazil

**P2: PLANTARIS EXCISION AND ACHILLES SCRAPING IMPROVES PAIN AND STRUCTURE: A LONG TERM CASE SERIES**

L A Masci<sup>1</sup>, H Alfredson<sup>2</sup>, B Neal<sup>3</sup>, W Wynter Bee<sup>1</sup>, D Morrissey<sup>3</sup>

<sup>1</sup>ISEH, LONDON, United Kingdom

<sup>2</sup>Pure Sports Medicine, LONDON, United Kingdom

<sup>3</sup>Queen Mary University of London, LONDON, United Kingdom

**P3: PRESERVATION OF TENDON FASCICLE FAILURE STRESS IN OVERIECTOMIZED RATS FOLLOWING PHYSTOESTROGEN TREATMENT: ROLE FOR TENOMODULIN?**

CC Carroll<sup>1</sup>, SH Patel<sup>1</sup>, BDH Gordon<sup>2</sup>, R Howden<sup>3</sup>

<sup>1</sup>Purdue University, WEST LAFAYETTE, United States of America

<sup>2</sup>University of North Carolina at Charlotte, CHARLOTTE, United States of America

<sup>3</sup>United States of America

**P4: ECCENTRIC TRAINING FOR TENDON HEALING AFTER ACUTE LESION: A RAT MODEL**

JF Kaux<sup>1</sup>, V Libertiaux<sup>2</sup>, P Leprince<sup>2</sup>, M Fillet<sup>2</sup>, V Denoël<sup>2</sup>, C Lecut<sup>2</sup>, A Gothot<sup>2</sup>, C Le Goff<sup>2</sup>, JL Croisier<sup>2</sup>, PV Drion<sup>2</sup>

<sup>1</sup>University of Liège, LIÈGE, Belgium

<sup>2</sup>Belgium

**P5: SPANISH CONSENSUS STATEMENT CLINICAL MANAGEMENT OF TENDINOPATHIES IN SPORT**

G Alvarez-Rey<sup>1</sup>, GESMUTE Spanish Group for tendon study<sup>2</sup>

<sup>1</sup>AMS, MALAGA, Spain

<sup>2</sup>MADRID, Spain

**P6: DOES SPORTS TAPE CORRECT GAIT ABNORMALITIES IN WOMEN WITH GTPS? A DOUBLE-BLIND RANDOMISED CROSSOVER TRIAL**

NA Robinson<sup>1</sup>, W Spratford<sup>2</sup>, J Gaida<sup>2</sup>, M Welvaert<sup>2</sup>, AM Fearon<sup>2</sup>

<sup>1</sup>CANBERRA, Australia

<sup>2</sup>University of Canberra, CANBERRA, Australia

**P7: HOW DO PHYSIOTHERAPISTS ASSESS AND MANAGE GREATER TROCHANTERIC PAIN SYNDROME?**

HP French<sup>1</sup>, L O'Connor<sup>1</sup>, A Grimaldi<sup>2</sup>, S Woodley<sup>3</sup>, A Fearon<sup>4</sup>

<sup>1</sup>Royal College of Surgeons in Ireland, DUBLIN, Ireland

<sup>2</sup>Physiotec Physiotherapy, BRISBANE, Australia

<sup>3</sup>University of Otago, OTAGO, New Zealand

<sup>4</sup>University of Canberra, CANBERRA, Australia

**P8: DOES SURGERY WORK FOR TENDINOPATHY? A SYSTEMATIC REVIEW OF RANDOMISED STUDIES**

D Challoumas<sup>1</sup>, M McLean<sup>2</sup>, P Kirwan<sup>2</sup>, NL Millar<sup>2</sup>

<sup>1</sup>University of Glasgow, United Kingdom

<sup>2</sup>United Kingdom

**P9: VIBRATION TRAINING REDUCES PAIN AND FUNCTIONAL LIMITATIONS IN PATIENTS WITH PATELLAR TENDINOPATHY**

F Rieder<sup>1</sup>, H-P Wiesinger<sup>1</sup>, J Herfert<sup>2</sup>, K Lampl<sup>2</sup>, A Kösters<sup>1</sup>, Y Landkammer<sup>2</sup>, R Sassmann<sup>2</sup>, S Hecht<sup>2</sup>, N Maffulli<sup>3</sup>, A Wicker<sup>2</sup>, E Müller<sup>1</sup>, O R Seynnes<sup>4</sup>

<sup>1</sup>University of Salzburg, SALZBURG, Austria

<sup>2</sup>Paracelsus Medical University, SALZBURG, Austria

<sup>3</sup>Barts and The London School of Medicine and Dentistry Mile End Hospital, LONDON, United Kingdom

<sup>4</sup>Norwegian School of Sport Sciences, OSLO, Norway

**P10: A SYSTEMATIC REVIEW OF CLINICAL TRIALS OF EXERCISE FOR TIBIALIS POSTERIOR TENDINOPATHY**

MH Ross, MD Smith, R Mellor, B Vicenzino

The University of Queensland, ST LUCIA, Australia

**P11: THE USE OF PLATELET-RICH PLASMA (PRP) TO TREAT CHRONIC TENDINOPATHIES: A TECHNICAL ANALYSIS**

JF Kaux<sup>1</sup>, T Emonds-Alt<sup>2</sup>

<sup>1</sup>University of Liège, LIÈGE, Belgium

<sup>2</sup>Belgium

**P12: COMPARISON OF PLATELET-RICH PLASMA VERSUS HYALURONIC ACID INJECTIONS TO TREAT PATELLAR TENDINOPATHIES**

JF Kaux<sup>1</sup>, N Dardenne<sup>2</sup>, JL Croisier<sup>2</sup>

<sup>1</sup>University of Liège, LIÈGE, Belgium

<sup>2</sup>Belgium

11.30 Poster session P1-P85

12.00 Lunch and exhibition visit

**Session Imaging**

**Chairs: Dr. Robert-Jan de Vos & Jamie Gaida**

13.00 Keynote 2 – Imaging of Tendons: New Developments

**Dr. Edwin Oei, The Netherlands**

13.30 Free communication session B6-B10

**B6: NON-UNIFORM DEFORMATION IN ACHILLES TENDON NOT INFLUENCED BY KNEE ANGLE OR LEVEL OF FORCE PRODUCTION**

Stijn Bogaerts<sup>1</sup>, Catarina De Brito Carvalho<sup>2</sup>, An De Groef<sup>1</sup>, Paul Suetens<sup>3</sup>, Koen Peers<sup>1</sup>

<sup>1</sup>University Hospitals Leuven, LEUVEN, Belgium

<sup>2</sup>INESC TEC Porto, Instituto de Engenharia de Sistemas e Computadores - Tecnologia, PORTO, Portugal

<sup>3</sup>ESAT/PSI & UZ Leuven, MIRC, KU Leuven and University Hospitals Leuven, LEUVEN, Belgium

**B7: SHEAR WAVE ELASTOGRAPHY DEMONSTRATES REDUCED PATELLAR TENDON ELASTICITY IN JUMPING ATHLETES WITH PATELLAR TENDINOPATHY**

S.J. Breda, R.J. de Vos, G.P. Krestin, E.H.G. Oei

Erasmus MC, ROTTERDAM, Nederland

**B8: SIX-WEEKS OF INTENSIVE REHEARSALS PRIOR TO SWAN LAKE, SHOWS STRUCTURAL CHANGES OF THE ACHILLES TENDONS IN BALLET DANCERS**

Anker-Petersen C <sup>1,2</sup>, Thorborg K <sup>2</sup>, Antflick J <sup>3</sup>, Aagaard H <sup>4</sup>, Myers C <sup>3</sup>, Ploug Boesen A <sup>2</sup>, Hölmich P <sup>2</sup>, Juul-Kristensen B <sup>1</sup>

<sup>1</sup>Department of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark

<sup>2</sup>Sports Orthopedic Research Center-Copenhagen, Department of Orthopedic Surgery, Amager-Hvidovre Hospital, Copenhagen University Hospital, Denmark

<sup>3</sup>Tendon Performance, London, UK

<sup>4</sup>Department of Orthopedic Surgery, Sjaelland University Hospital, Køge, Denmark

**B9: AXIAL STRAIN ELASTOGRAPHY IN YOUTH BASKETBALL PLAYERS WITH PATELLAR TENDINOPATHY**

OBA Owoeye <sup>1</sup>, REA Walker <sup>1</sup>, Y Chadha <sup>2</sup>, JP Wiley <sup>1</sup>, L McLeod <sup>1</sup>, T Hubka <sup>1</sup>, CA Emery <sup>1</sup>

<sup>1</sup>University of Calgary, CALGARY, Canada

<sup>2</sup>North York General Hospital, TORONTO, Canada

**B10: SCREENING ELITE RUGBY PLAYERS WITH UTC YIELDS USEFUL IN-SEASON INJURY RISK INFORMATION: A COHORT STUDY**

L A Masci <sup>1</sup>, V Tank <sup>2</sup>, S Miller <sup>2</sup>, D Morrissey <sup>2</sup>

<sup>1</sup>ISEH, LONDON, United Kingdom

<sup>2</sup>Queen Mary University of London, LONDON, United Kingdom

14.30

Poster Pitch P13-P25

**P13: MORPHOMECHANICAL OUTCOMES OF THE TRICEPS SURAE MUSCLE-TENDON AFTER AN ACHILLES TENDON REPAIR**

WC Peng <sup>1</sup>, CS Wen <sup>2</sup>, LC Lin <sup>3</sup>, HK Wang <sup>4</sup>

<sup>1</sup>National Taiwan University, TAIPEI, Taiwan

<sup>2</sup>Chen Hsin General Hospital, TAIPEI, Taiwan

<sup>3</sup>Tri-Service General Hospital, TAIPEI, Taiwan

<sup>4</sup>National Taiwan University Hospital, TAIPEI, Taiwan

**P14: FREQUENCY OF PATHOLOGY ON DIAGNOSTIC ULTRASOUND IN INDIVIDUALS WITH INSERTIONAL ACHILLES TENDINOPATHY**

K Grävare Silbernagel <sup>1</sup>, J Zellers <sup>1</sup>, N Alghamdi <sup>1</sup>, R Pholig <sup>1</sup>, B Bley <sup>2</sup>

<sup>1</sup>University of Delaware, NEWARK, United States of America

<sup>2</sup>Delaware Orthopaedic Specialists, NEWARK, United States of America

**P15: PROGNOSTIC FACTORS FOR OUTCOME FOLLOWING EXERCISE INTERVENTIONS FOR ACHILLES TENDINOPATHY: A SYSTEMATIC REVIEW AND META-ANALYSIS**

K Färnqvist <sup>1</sup>, D Morrissey <sup>1</sup>, A Chauhan <sup>1</sup>, P Malliaras <sup>2</sup>

<sup>1</sup>STOCKHOLM, Sweden

<sup>2</sup>Monash University, MELBOURNE, Australia

**P16: ALTERATION ON PATELLA TENDON SHEAR MODULUS IN FEMALES WITH KNEE OSTEOARTHRITIS**

CC Huang, SN Fu

The Hong Kong Polytechnic University, Hong Kong, HONG KONG, Hongkong

**P17: MRI MEASUREMENT ON WATER CONTENT IN PATELLAR TENDON: ITS RELATIONSHIP WITH TENDON STIFFNESS AND PAIN**

SN Fu <sup>1</sup>, Z Cai <sup>1</sup>, W Zhang <sup>2</sup>, J Fang <sup>2</sup>, J Li <sup>3</sup>, P Luo <sup>4</sup>

<sup>1</sup>The Hong Kong Polytechnic University, Hong Kong, HONG KONG, Hongkong

<sup>2</sup>Sports Hospital, Ersha Sports Training Centre, Guang Zhou, China, GUANG ZHOU, China

<sup>3</sup>Sports Bureau of Guangdong Province Guangdong, China, GUANG ZHOU, China

<sup>4</sup>GuangDong Vocational Institute of Sports, China, GUANG ZHOU, China

**P18: PATELLAR TENDON COMPLIANCE IS ASSOCIATED WITH HOP DISTANCE IN MALE BUT NOT FEMALE ATHLETES**

Z Cai<sup>1</sup>, P Luo<sup>2</sup>, SN Fu<sup>1</sup>, W Zhang<sup>3</sup>, J Fang<sup>3</sup>, J Li<sup>4</sup>

<sup>1</sup>The Hong Kong Polytechnic University, Hong Kong, HONG KONG, Hongkong

<sup>2</sup>GuangDong Vocational Institute of Sports, China, GUANG ZHOU, China

<sup>3</sup>Sports Hospital, Ersha Sports Traiing Centre, Guang Zhou, China, GUANG ZHOU, China

<sup>4</sup>Sports Bureau of GuangDong Province GuangDong, China, GUANG ZHOU, China

**P19: NEOVASCULARIZATION IN PATIENTS WITH ACHILLES TENDINOPATHY: IS SURFACE AREA QUANTIFICATION A RELIABLE METHOD?**

AC van der Vlist, JM Veen, JAN Verhaar, RJ De Vos

Erasmus MC University Medical Center, ROTTERDAM, Netherlands

**P20: DOES THE ACHILLES TENDON RESPOND TO A GAME OF RUGBY: ULTRASOUND TISSUE CHARACTERISATION STUDY**

M Green, S O'Neill

University of Leicester, LEICESTER, United Kingdom

**P21: VALIDATION OF ULTRASOUND TISSUE CHARACTERISATION IN HUMANS**

M. Green, S O'Neill, S Byrne

University of Leicester, LEICESTER, United Kingdom

**P22: BILATERAL CHANGES IN TENDON STRUCTURE OF PATIENTS DIAGNOSED WITH UNILATERAL ACHILLES AND PATELLAR TENDINOPATHY**

L Maciel Rabello, I van den Akker-Scheek, IF Kuipers, RL Diercks, MS Brink, J Zwerver

University Medical Center Groningen, RUG, GRONINGEN, Nederland

**P23: SUBSTANTIATING THE USE OF ULTRASOUND TISSUE CHARACTERIZATION IN THE ANALYSIS OF TENDON STRUCTURE**

L.M. Rabello<sup>1</sup>, O.C. Dams<sup>1</sup>, I. Van den Akker-Scheek<sup>1</sup>, J. Zwerver<sup>1</sup>, S. O'Neill<sup>2</sup>

<sup>1</sup>University of Groningen, University Medical Center Groningen, GRONINGEN, Nederland

<sup>2</sup>University of Leicester, LEICESTER, United Kingdom

**P24: EPIDEMIOLOGY OF PATELLAR TENDINOPATHY IN CRICKET: HIGH PREVALENCE OF STRUCTURAL CHANGES AMONG ASYMPTOMATIC FAST BOWLERS**

C. Cooper<sup>1</sup>, A. Rodrigues<sup>1</sup>, S. McCaig<sup>2</sup>, B.D. Kumar<sup>1</sup>

<sup>1</sup>Institute of Sport, Exercise and Health, LONDON, United Kingdom

<sup>2</sup>English Cricket Board, LOUGHBOROUGH, United Kingdom

**P25: DOES REPORTING OF IMAGING FINDINGS AFFECT PATIENT'S PERCEPTION OF TREATMENT EFFICACY IN ACHILLES TENDINOPATHY?**

SI Docking, J Cook, E Rio, C Rabusin, S Munteanu

La Trobe University, BUNDOORA, Australia

15.00 Poster session P1-P85

15.30 Break and exhibition visit

16.00 Free communication session C11-C15

**C11: DOES TENDON STRUCTURE CORRELATES WITH CLINICAL STATUS AFTER CONSERVATIVE TREATMENT IN PATIENTS WITH ACHILLES/PATELLAR TENDINOPAHY?**

L Maciel Rabello, I van den Akker-Scheek, D Berns, RL Diercks, MS Brink, J Zwerver

University Medical Center Groningen, RUG, GRONINGEN, Nederland

**C12: USING MYOMETRIC MEASUREMENTS TO ASSESS STIFFNESS OF TENDINOPATHIC ACHILLES TENDONS**

N. Kram<sup>1</sup>, G Radovanovic<sup>2</sup>, K Legerlotz<sup>2</sup>

<sup>1</sup>Chemnitz University of Technology, CHEMNITZ, Germany

<sup>2</sup>Humboldt-Universität zu Berlin, BERLIN, Germany

**C13: PLYOMETRIC EXERCISE INDUCES GREATER ACHILLES TENDON RESPONSE THAN TREADMILL RUNNING: A RANDOMISED CROSS-OVER UTC STUDY**

A. Rodrigues, B.D. Kumar

Institute of Sport, Exercise and Health, LONDON, United Kingdom

**C14: DOES IN VIVO MECHANICAL LOADING OF THE TIBIA AFFECTS THE ACHILLES TENDON IN MICE?**

Viviane Fleischhacker<sup>1</sup>, Susann Minkwitz<sup>1</sup>, Franka Klatte-Schulz<sup>1</sup>, Max Rummler<sup>2</sup>, Anne Seliger<sup>1</sup>, Bettina Willie<sup>2</sup>, Britt Wildemann<sup>1</sup>

<sup>1</sup>Charité-Universitätsmedizin Berlin, BERLIN, Germany

<sup>2</sup>McGill University, MONTREAL, Canada

**C15: DIABETIC ACHILLES TENDONS ARE THICKER AND DISPLAY ABNORMAL SHEARWAVE ELASTOGRAPHIC FINDINGS**

BK Coombes<sup>1</sup>, K Tucker<sup>1</sup>, F Hug<sup>2</sup>, A Scott<sup>3</sup>, M Geytenbeek<sup>1</sup>, T Gajanand<sup>1</sup>, JS Coombes<sup>1</sup>

<sup>1</sup>The University of Queensland, BRISBANE, Australia

<sup>2</sup>University of Nantes, NANTES, France

<sup>3</sup>The University of British Columbia, VANCOUVER, Canada

**Session 'What can we learn from'**

**Speakers: Prof. dr. Gerjo van Osch & Dr. Koen Bos**

17.00 What can we learn from osteo-arthritis?

*Intro basic science and clinic*

*Interactive discussion*

18.00-19.00 Welcome reception (Fountain Patio - UMCG)

*This reception is offered to you by the University of Groningen, the Municipality of Groningen and the Province of Groningen.*

**FRIDAY, SEPTEMBER 28, 2018**

08.00 – 08.45 *Blue Room: 'Consensus statements for Core Domain Set, Clinical Terminology, and Minimum Reporting Recommendations for Baseline Characteristics'*

08.00 Upload Desk open

08.30 Reception with Coffee

**Session Metabolic Disease & Tendon Disorders**

**Chairs: Prof.dr. Ron Diercks & Dr. Stijn Bogaerts**

09.00 Keynote 3 - Metabolic Disease & Tendon Disorders

**Dr. Michele Abate, Italy**



09.30

Free communication session D16-D20

**D16: EXPERIMENTAL DIABETES ALTERS THE MORPHOLOGY AND NANO-STRUCTURE OF THE ACHILLES TENDON**

RR de Oliveira<sup>1</sup>, MNM Oliveira<sup>2</sup>, RM Mattos<sup>3</sup>, F Tovar-Moll<sup>3</sup>, LE Nasciutti<sup>3</sup>, GAC Brito<sup>1</sup>

<sup>1</sup>Federal University of the Ceará, FORTALEZA, Brazil

<sup>2</sup>Tendon Research Group Brazil, FORTALEZA, Brazil

<sup>3</sup>Institute of Biomedical Sciences, Federal University of Rio de Janeiro, RIO DE JANEIRO, Brazil

**D17: GLUCOCORTICOID EXPOSURE MAY EXPLAIN THE ASSOCIATION BETWEEN METABOLIC DYSFUNCTION AND TENDINOPATHY**

T. Lewis<sup>1</sup>, J. E. Gaida<sup>2</sup>, E. Zeisig<sup>3</sup>

<sup>1</sup>Aintree University Hospital, Liverpool, United Kingdom

<sup>2</sup>University of Canberra, CANBERRA, Australia

<sup>3</sup>Umeå University, UMEÅ, Sweden

**D18: SCREEN'D'EM BEFORE YOU TREAT'EM A CLINICAL TOOL TO HELP IDENTIFY SPONDYLOARTHROPATHY IN PATIENTS WITH TENDINOPATHY**

P. Kirwan<sup>1</sup>, J. March<sup>2</sup>, T Duffy<sup>3</sup>

<sup>1</sup>Royal College of Surgeons in Ireland, DUBLIN, Ireland

<sup>2</sup>Chewshealth, BARNSLEY, United Kingdom

<sup>3</sup>Connolly Hospital, DUBLIN, Ireland

**D19: DANGER SIGNALLING IN TENDINOPATHY: A VITAL ROLE FOR HMGB1**

M Akbar<sup>1</sup>, M Garcia-Melchor<sup>1</sup>, S Kitson<sup>1</sup>, M McLean<sup>1</sup>, L A N Crowe<sup>1</sup>, G A C Murrell<sup>2</sup>, I B M McInnes<sup>1</sup>, G S Gilchrist<sup>1</sup>, N L Millar<sup>1</sup>

<sup>1</sup>University of Glasgow, GLASGOW, United Kingdom

<sup>2</sup>University of New South Wales, SYDNEY, Australia

**D20: ADVANCED GLYCATION END-PRODUCT INDUCED MITOCHONDRIAL DYSFUNCTION IN TENOCYTES**

SH Patel, ZR Hettinger, R Foguth, F Yue, S Kuang, JR Cannon, J Shannahan, CC Carroll  
Purdue University, WEST LAFAYETTE, United States of America

10.30

Poster Pitch P26-35

**P26: CHARACTERISING THE FUNCTIONAL EFFECTS OF PROTEOGLYCAN AND ANGIOGENESIS GENES ON ACHILLES TENDINOPATHY RISK**

M Rahim, K Willard, M-J Laguette, M Collins, AV September  
University of Cape Town, CAPE TOWN, South Africa

**P27: ALARMIN S100A8 AND S100A9 MODULATE THE INFLAMMATORY MICROENVIRONMENT IN EARLY TENDINOPATHY**

L A N Crowe<sup>1</sup>, K Patommel<sup>1</sup>, M Akbar<sup>1</sup>, E Garcia Melchor<sup>1</sup>, S M Kitson<sup>2</sup>, M M McLean<sup>1</sup>, I B McInnes<sup>2</sup>, N L Millar<sup>1</sup>

<sup>1</sup>University of Glasgow, GLASGOW, United Kingdom

<sup>2</sup>United Kingdom

**P28: IS AN EQUINE TENDON MODEL SUITABLE FOR STUDYING SHEAR MECHANICS WITHIN HUMAN ACHILLES TENDON?**

N. Yin, H. L. Birch

University College London, LONDON, United Kingdom

**P29: WHOLE EXOME SEQUENCING TO CHARACTERIZE SUSCEPTIBILITY LOCI FOR TENDON INJURIES**

AV September<sup>1</sup>, A Gibbon<sup>1</sup>, CJ Saunders<sup>2</sup>, M Collins<sup>3</sup>, J Gamielien<sup>4</sup>

<sup>1</sup>Division of Exercise Science, CAPE TOWN, South Africa

<sup>2</sup>Division of Emergency Medicine, Department of Surgery, Faculty of Health Science, CAPE TOWN, South Africa

<sup>3</sup>Division of Exercise Science and Sports Medicine, Department of Human Biology,, UNIVERSITY OF CAPE TOWN, CAPE TOWN, South Africa

<sup>4</sup>South African National Bioinformatics Institute/SA MRC Unit for Bioinformatics C, CAPE TOWN, South Africa

**P30: EXPERIMENTAL DIABETES INDUCES STRUCTURAL AND VASCULAR CHANGES OF ACHILLES TENDONS**

RR de Oliveira<sup>1</sup>, MNM Oliveira<sup>2</sup>, RM Mattos<sup>3</sup>, GAC Brito<sup>1</sup>, LE Nasciutti<sup>3</sup>

<sup>1</sup>Federal University of the Ceará, FORTALEZA, Brazil

<sup>2</sup>Tendon Research Group Brazil, FORTALEZA, Brazil

<sup>3</sup>Institute of Biomedical Sciences, Federal University of Rio de Janeiro, RIO DE JANEIRO, Brazil

**P31: APOLIPOPROTEIN A1 DISTRIBUTION PATTERN IN THE HUMAN ACHILLES TENDON**

J. E. Gaida<sup>1</sup>, H. Alfredson<sup>2</sup>, A. Scott<sup>3</sup>, R. Mousavizadeh<sup>3</sup>, S Forsgren<sup>2</sup>

<sup>1</sup>University of Canberra, CANBERRA, Australia

<sup>2</sup>Umeå University, UMEÅ, Sweden

<sup>3</sup>University of British Columbia, VANCOUVER, Canada

**P32: LONG-TERM RESULTS OF SCRAPING PROCEDURE AND PLANTARIS TENDON REMOVAL IN CHRONIC MIDPORTION ACHILLES TENDINOPATHY**

H Alfredson<sup>1</sup>, A Ruergard<sup>2</sup>, C Spang<sup>1</sup>

<sup>1</sup>Umea University, UMEA, Sweden

<sup>2</sup>Sweden

**P33: RISK FACTORS FOR ACHILLES TENDINOPATHY IN RUNNERS; A LARGE PROSPECTIVE COHORT STUDY**

IF Lagas, T Fokkema, SMA Bierma-Zeinstra, JAN Verhaar, M Middelkoop, RJ De Vos  
Erasmus MC, University Medical Center Rotterdam, ROTTERDAM, Netherlands

**P34: BEST PRACTICE IN MANAGEMENT OF PLANTAR HEEL PAIN: INCORPORATING SYSTEMATIC REVIEW WITH EXPERT CLINICAL REASONING**

D Morrissey<sup>1</sup>, M Cotchett<sup>2</sup>, Ahmed Said J'Bari<sup>1</sup>, C Barton<sup>2</sup>, M Rathleff<sup>3</sup>, I Griffiths<sup>1</sup>, T Prior<sup>1</sup>, B Vicenzino<sup>4</sup>

<sup>1</sup>QMUL, LONDON, United Kingdom

<sup>2</sup>LaTrobe University, MELBOURNE, Australia

<sup>3</sup>Research Unit for General Practice in Aalborg, AALBORG, Denmark

<sup>4</sup>University of Queensland, BRISBANE, Australia

**P35: FROM ACHILLES TENDINOPATHY TO ACHILLES TENDON RUPTURE: A COMPARISON OF PATIENTS IN TWO INDEPENDENT COHORTS.**

AH Veldman, OC Dams, I Van den Akker-Scheek

University of Groningen, University Medical Center Groningen, GRONINGEN, Nederland

11.00

Break and exhibition visit

## Session Tendon Pain

**Chairs: Dr. Inge van den Akker-Scheek & Dr. Jon Rees**

11.30 Keynote 4 - Tendon Pain  
**Dr. Ebonie Rio, Australia**

12.00 Free communication session E21-E25  
**E21: PRELIMINARY FINDINGS OF A CROSS-SECTIONAL STUDY OF SENSORY, PHYSICAL AND PSYCHOSOCIAL FEATURES IN GLUTEAL TENDINOPATHY**  
ML Plinsinga, BK Coombes, G Cleary, R Mellor, B Vicenzino  
The University of Queensland, BRISBANE, Australia

**E22: STRUCTURAL, FUNCTIONAL, AND SYMPTOMATIC DIFFERENCES IN PATIENTS WITH INSERTIONAL OR MIDPORTION ACHILLES TENDINOPATHY**  
K Grävare Silbernagel, N Alghamdi, P Corrigan  
University of Delaware, NEWARK, United States of America

**E23: THE EFFECT OF HIGH LOADING FOR REHABILITATION TREATMENT IN CHRONIC ACHILLES TENDINOPATHY**  
G Radovanovic<sup>1</sup>, K Peper<sup>2</sup>, S Bohm<sup>2</sup>, A Arampatzis<sup>2</sup>, K Legerlotz<sup>2</sup>  
<sup>1</sup>Humboldt-University Berlin / Institute for Sport Sciences, 10099 BERLIN, Germany  
<sup>2</sup>Humboldt-Universität zu Berlin / Dept of Training and Movement Sciences BERLIN, Germany

**E24: PEOPLE WITH ACHILLES TENDINOPATHY DISPLAY GREATER FORCE FLUCTUATIONS THAN CONTROLS AT LOW FORCE LEVELS**  
P Malliaras, D Tomassoni, F Hasani, T Allen, D Kidgell  
Monash University, MELBOURNE, Australia

**E25: EXTRACORPOREAL SHOCK WAVE THERAPY OF HEALTHY ACHILLES TENDONS RESULTS IN A CONDITIONED PAIN MODULATION EFFECT**  
P Vallance, P Malliaras  
Monash University, MELBOURNE, Australia

13.00 Lunch and exhibition visit

14.00 Free communication session F26-F30  
**F26: LOWER ANKLE DORSIFLEXION IS ASSOCIATED WITH TENDON PATHOLOGY, DISABILITY AND PAIN IN ELITE JUMPING ATHLETES**  
RSS Rodrigo Scattone Silva<sup>1</sup>, CP Craig Purdam<sup>2</sup>, AF Angela Fearon<sup>3</sup>, WS Wayne Spratford<sup>3</sup>, PP Peter Preston<sup>4</sup>, FVS Fábio V. Serrão<sup>5</sup>, JG James Gaida<sup>3</sup>  
<sup>1</sup>Post-Graduate Program in Rehabilitation Sciences (FACISA), SANTA CRUZ, Brazil  
<sup>2</sup>Australian Institute of Sport, CANBERRA, Australia  
<sup>3</sup>Research Institute for Sport and Exercise (UCRISE), University of Canberra, CANBERRA, Australia  
<sup>4</sup>Canberra Specialist Ultrasound, CANBERRA, Australia  
<sup>5</sup>Federal University of São Carlos (UFSCar), SÃO CARLOS, Brazil

**F27: QUALITY-OF-LIFE IN ACHILLES TENDINOPATHY**  
J. E. Gaida, J. E. Gaida, R. J. Keegan  
University of Canberra, CANBERRA, Australia

**F28: THE PREVALENCE OF SELF-REPORTED PSYCHOLOGICAL CHARACTERISTICS OF ADULTS WITH LOWER LIMB TENDINOPATHY**  
J Mest<sup>1</sup>, B Vaughan<sup>2</sup>, J Mulcahy<sup>3</sup>, P Malliaras<sup>4</sup>  
<sup>1</sup>Capital Clinic Physiotherapy, Canberra, Australia  
<sup>2</sup>University of Melbourne, Melbourne, Australia  
<sup>3</sup>Victoria University, Melbourne, Australia  
<sup>4</sup>Monash University, MELBOURNE, Australia

**F29: CHARACTERISATION OF ACHILLES TENDON PAIN USING MULTIPLE MULTIDIMENSIONAL PAIN SCALES**

NS Mkumbuzi<sup>1</sup>, AV September<sup>1</sup>, M Posthumus<sup>2</sup>, M Collins<sup>1</sup>

<sup>1</sup>University of Cape Town, CAPE TOWN, South Africa

<sup>2</sup>Sports Science Institute of South Africa, CAPE TOWN, South Africa

**F30: A PILOT CROSS-SECTIONAL STUDY OF PAIN IN INDIVIDUALS WITH PERSISTENT PLANTAR FASCIOPATHY**

H Riel<sup>1</sup>, M Plinsinga<sup>2</sup>, R Mellor<sup>2</sup>, SA Boudreau<sup>3</sup>, V Vuvan<sup>2</sup>, G Cleary<sup>2</sup>, B Vicenzino<sup>2</sup>

<sup>1</sup>Research Unit for General Practice in Aalborg, AALBORG, Denmark

<sup>2</sup>The University of Queensland, ST. LUCIA, Australia

<sup>3</sup>Center for Sensory-Motor Interaction (SMI), AALBORG, Denmark

15.00

Poster Pitch P36-P48

**P36: THE ROLE OF INFLAMMATION IN ACHILLES TENDINOPATHY: INTERLEUKIN-6 LEVELS DROP AFTER PHYSIOTHERAPEUTIC INTERVENTION**

K Legerlotz, G Radovanovic

Institute for Sport Science / Humboldt-Universität zu Berlin, BERLIN, Germany

**P37: CHARACTERIZATION OF THE BURSA SUBACROMIALIS AND ITS CORRELATION TO THE SEVERITY OF SSP TEAR**

Franka Klatte-Schulz, Thanh Huyen Nguyen, Susann Minkwitz, Kathi Thiele, Markus Scheibel, Britt Wildemann

Charité-Universitätsmedizin Berlin, BERLIN, Germany

**P38: KINETIC CHAIN STRENGTH AND PSYCHOSOCIAL ASPECTS IN RECREATIONAL RUNNERS WITH AT: A CASE CONTROL STUDY**

I Sancho<sup>1</sup>, C Barton<sup>2</sup>, D Morrissey<sup>1</sup>, P Malliaras<sup>3</sup>

<sup>1</sup>Queen Mary University of London, LONDON, United Kingdom

<sup>2</sup>La Trobe University, MELBOURNE, Australia

<sup>3</sup>Monash University, MELBOURNE, Australia

**P39: TIME COURSE CHANGES IN ACHILLES TENDON GEOMETRY AND SELF-REPORTED PAIN IN MID-PORTION ACHILLES TENDINOPATHY**

R Newsham-West<sup>1</sup>, L Nuri<sup>1</sup>, S Obst<sup>2</sup>, RS Barrett<sup>1</sup>

<sup>1</sup>Griffith University, GOLD COAST, Australia

<sup>2</sup>University of Central Queensland, BUNDABERG, Australia

**P40: CLINICAL AND PSYCHOLOGICAL FEATURES IN POSTERIOR TIBIAL TENDON DYSFUNCTION: PRELIMINARY FINDINGS**

MH Ross, MD Smith, B Vicenzino

The University of Queensland, ST LUCIA, Australia

**P41: INJURIES AND LOWER EXTREMITY TENDINOPATHIES IN YOUTH BASKETBALL: A PROSPECTIVE COHORT STUDY**

OBA Owoeye, K Befus, J Choi, B Ghali, T Hubka, LM Palacios-Derflingher, K Pasanen, CA Emery,

JP Wiley

University of Calgary, CALGARY, Canada

**P42: DIAGNOSTIC ACCURACY OF A SELF-REPORT MEASURE OF PATELLAR TENDINOPATHY IN YOUTH BASKETBALL**

OBA Owoeye, JP Wiley, REA Walker, LM Palacios-Derflingher, CA Emery

University of Calgary, CALGARY, Canada

**P43: BEST PRACTICE MANAGEMENT OF MID-PORTION-ACHILLES-TENDINOPATHY: INCORPORATING LEVEL 1 EVIDENCE WITH EXPERT CLINICAL REASONING**

D Morrissey<sup>1</sup>, Fadi Hassan<sup>1</sup>, S Morton<sup>1</sup>, C Barton<sup>2</sup>, P Malliaras<sup>3</sup>

<sup>1</sup>QMUL, LONDON, United Kingdom

<sup>2</sup>LaTrobe University, MELBOURNE, Australia

<sup>3</sup>Monash University, MELBOURNE, Australia

**P44: CROSS-SECTIONAL STUDY OF SOMATOSENSORY AND PSYCHOSOCIAL FEATURES, AND CO-MORBID PAIN CONDITIONS IN SEVERE LATERAL EPICONDYLALGIA**

V Vuvan<sup>1</sup>, R Mellor<sup>1</sup>, B K Coombes<sup>2</sup>, L J Heales<sup>3</sup>, P Hodges<sup>1</sup>, M Farrell<sup>4</sup>, B Vicenzino<sup>1</sup>

<sup>1</sup>School of Health and Rehabilitation Sciences, The University of Queensland, BRISBANE, Australia

<sup>2</sup>School of Biomedical Sciences, The University of Queensland, BRISBANE, Australia

<sup>3</sup>School of Health, Medical, and Applied Sciences, Central Queensland University, ROCKHAMPTON, Australia

<sup>4</sup>School of Primary and Allied Health Care, Monash University, CLAYTON, Australia

**P45: WHICH RUNNERS TRANSIT FROM REACTIVE TO CHRONIC ACHILLES TENDINOPATHY? A LARGE PROSPECTIVE CHORT STUDY**

IF Lagas, T Fokkema, SMA Bierma-Zeinstra, JAN Verhaar, M Middelkoop, RJ De Vos

Erasmus MC, University Medical Center Rotterdam, ROTTERDAM, Netherlands

**P46: ULTRASOUND-GUIDED TENDON DEBRIDEMENT EFFECTS ON PATELLAR TENDINOPATHY PAIN AND STRUCTURE: A CASE SERIES**

L A Masci<sup>1</sup>, H Alfredson<sup>2</sup>, B Neal<sup>2</sup>, W Wynter Bee<sup>1</sup>, D Morrissey<sup>3</sup>

<sup>1</sup>ISEH, LONDON, United Kingdom

<sup>2</sup>Pure Sports Medicine, LONDON, United Kingdom

<sup>3</sup>Queen Mary University of London, LONDON, United Kingdom

**P47: PATELLAR TENDINOPATHY OUTCOME PREDICTORS IN COMPETITIVE ATHLETES: A FEASIBILITY STUDY FOR A MULTI-LEVEL COHORT STUDY**

A Tayfur, JI Salles, D Morrissey

Queen Mary University of London, LONDON, United Kingdom

**P48: OUTCOME PREDICTORS OF PLANTAR HEEL PAIN: A FEASIBILITY STUDY FOR MULTI-LEVEL COHORT STUDY**

H Gulle, D Morrissey

Queen Mary University of London, LONDON, United Kingdom

15.30 Poster session P1-P85

16.00 Break and exhibition visit

**Session 'What can we learn from'**

**Speakers: Dr. Anneke Spoorenberg & Dr. Neal Millar**

16.30 What can we learn from spondylo-arthritis

*Intro basic science and clinic*

*Interactive discussion*

17.30 – 18.15 *Blue Room: 'Enhancing Research Surrounding Psychosocial Factors in Tendinopathy'*

18.30-00.00 Buffet & 'Tendinoholic' Lustrum Party

*Restaurant Het Heerenhuis - Spilsluizen 9, NL-9712 NR Groningen*

*T +31 (0)50 3120438*

*Music by Casino Royal*

## SATURDAY, SEPTEMBER 29, 2018

08.30 Reception with Coffee  
Upload Desk open

### Management of Ageing Tendon & Tendinopathy

**Chairs: Dr. Mathijs van Ark & Prof.dr. Jill Cook**

09.00 Keynote 5 - Management of Ageing Tendon & Tendinopathy  
Regulation of tendon biology and mechanical properties in ageing and collagen tissue turnover in tendinopathy

**Prof.dr. Michael Kjaer, Denmark**

09.30 Free communications session G31-G35

#### **G34: EFFECTS OF ECCENTRIC EXERCISE ON TENDON STIFFNESS MEASURED BY SHEAR-WAVE ELASTOGRAPHY IN ACHILLES TENDINOPATHY**

C Payne, P Baker, N Webborn, P Watt

University of Brighton, EASTBOURNE, United Kingdom

#### **G31: MEASURING PATIENT-REPORTED OUTCOMES (PROS/PROMS) IN PEOPLE WITH ACHILLES TENDINOPATHY: HOW USEFUL IS THE VISA-A?**

AJ Mallows<sup>1</sup>, C Littlewood<sup>2</sup>, P Malliaras<sup>3</sup>

<sup>1</sup>University of Essex, COLCHESTER, United Kingdom

<sup>2</sup>Keele University, STAFFORD, United Kingdom

<sup>3</sup>Monash University, MELBOURNE, Australia

#### **G32: CAN THERAPEUTIC ULTRASOUND IMPROVE PAIN IN PATIENTS WITH LOWER LIMBS TENDINOPATHIES?**

MCA Ventura<sup>1</sup>, MYO Santos<sup>2</sup>, PR Oliveira<sup>2</sup>, LS Arrebola<sup>2</sup>, AC Sardim<sup>2</sup>, CE Pinfildi<sup>2</sup>

<sup>1</sup>Federal University of São Paulo (Unifesp), SANTOS, Brazil

<sup>2</sup>Brazil

#### **G33: PLATELET-RICH PLASMA (PRP) AND TENDON HEALING: COMPARISON BETWEEN FRESH AND FROZEN-THAWED PRP**

JF Kaux<sup>1</sup>, V Libertiaux<sup>2</sup>, L Dupont<sup>2</sup>, A Colige<sup>2</sup>, V Denoël<sup>2</sup>, C Lecut<sup>2</sup>, A Gothot<sup>2</sup>, L Greimers<sup>2</sup>, PV Drion<sup>2</sup>

<sup>1</sup>University of Liège, LIÈGE, Belgium

<sup>2</sup>Belgium

#### **G35: ISOMETRIC VERSUS ISOTONIC EXERCISE FOR GREATER TROCHANTERIC PAIN SYNDROME**

C Clifford<sup>1</sup>, L Paul<sup>2</sup>, G Syme<sup>3</sup>, NL Millar<sup>4</sup>

<sup>1</sup>School of Medicine, Dentistry and Nursing, The University of Glasgow, GLASGOW, United Kingdom

<sup>2</sup>School of Health and Life Sciences, Glasgow Caledonian University, GLASGOW, United Kingdom

<sup>3</sup>Department of Physiotherapy, Victoria Hospital, Kirkcaldy, FIFE, United Kingdom

<sup>4</sup>Institute of Infection, Immunity and Inflammation, The University of Glasgow, GLASGOW, United Kingdom

10.30 Break and Poster session P1-P85

10.30 – 11.30 Fountain Patio: 'Meet & Greet with the chief-editor of Translational Sports Medicine'

11.00	<p>Free communication session H36-H40</p> <p><b>H36: EFFECT OF ISOMETRIC EXERCISE ON CLINICAL OUTCOMES IN PATIENTS WITH LATERAL EPICONDYLALGIA: RANDOMIZED CLINICAL TRIAL</b></p> <p><u>V Vuvan</u><sup>1</sup>, B Vicenzino<sup>1</sup>, R Mellor<sup>1</sup>, L J Heales<sup>2</sup>, B K Coombes<sup>3</sup></p> <p><sup>1</sup>School of Health and Rehabilitation Sciences, The University of Queensland, BRISBANE, Australia</p> <p><sup>2</sup>School of Health, Medical, and Applied Sciences, Central Queensland University, ROCKHAMPTON, Australia</p> <p><sup>3</sup>School of Biomedical Sciences, The University of Queensland, BRISBANE, Australia</p> <p><b>H37: HIGH-VOLUME INJECTION WITH AND WITHOUT CORTICOSTEROID IN ACHILLES TENDINOPATHY: A RANDOMISED DOUBLE BLIND PROSPECTIVE STUDY</b></p> <p>A Boesen<sup>1</sup>, R Hansen<sup>1</sup>, M Boesen<sup>1</sup>, <u>P Malliaras</u><sup>2</sup>, H Langberg<sup>1</sup></p> <p><sup>1</sup>Monash University, MELBOURNE, Australia</p> <p><sup>2</sup>Monash University, MELBOURNE, Australia</p> <p><b>H38: DOES HIGHER DOSE EXERCISE IMPROVE OUTCOMES IN ROTATOR CUFF TENDINOPATHY? A SYSTEMATIC REVIEW WITH META-ANALYSIS</b></p> <p><u>P Malliaras</u><sup>1</sup>, R Buchbinder<sup>2</sup>, G Seneque<sup>1</sup>, C Littlewood<sup>3</sup>, T Haines<sup>1</sup></p> <p><sup>1</sup>Monash University, MELBOURNE, Australia</p> <p><sup>2</sup>Cabrini Institute and Monash University, MALVERN, Australia</p> <p><sup>3</sup>Australia</p> <p><b>H39: A RANDOMISED CROSSOVER TRIAL OF THE INITIAL EFFECTS OF ISOMETRIC EXERCISE ON PLANTAR FASCIOPATHY</b></p> <p><u>H Riel</u><sup>1</sup>, B Vicenzino<sup>2</sup>, MB Jensen<sup>1</sup>, JL Olesen<sup>1</sup>, S Holden<sup>1</sup>, MS Rathleff<sup>1</sup></p> <p><sup>1</sup>Research Unit for General Practice in Aalborg, AALBORG, Denmark</p> <p><sup>2</sup>The University of Queensland, ST. LUCIA, Australia</p> <p><b>H40: THE 10,000 TENDONS STUDY: A MULTI-LEVEL INTERNATIONAL COHORT STUDY OF 5 TENDINOPATHIES.</b></p> <p><u>D Morrissey</u><sup>1</sup>, William Marsh<sup>1</sup>, Sean Williams<sup>2</sup></p> <p><sup>1</sup>QMUL, LONDON, United Kingdom</p> <p><sup>2</sup>Bath Unoversity, BATH, United Kingdom</p>
12.00	Prizes & Closing
12.30	(Take away) Lunch
12.30 – 13.00	<i>Blue Room: 'Consensus statements on tendinopathy: the next steps to ISTS 2020'</i>
13.30-15.30	<p>Room 16: Workshop 'Management of Achilles and Patellar tendinopathy'</p> <p><i>This workshop provides an up-to-date research and clinical perspective on the management of Achilles and Patellar</i></p> <p><b>Peter Malliaras, PhD</b></p> <p><i>Registration required</i></p>



# Abstracts

## Session Tendon Ageing

### Keynote 1 - Tendon ageing and the Interfascicular Matrix Niche

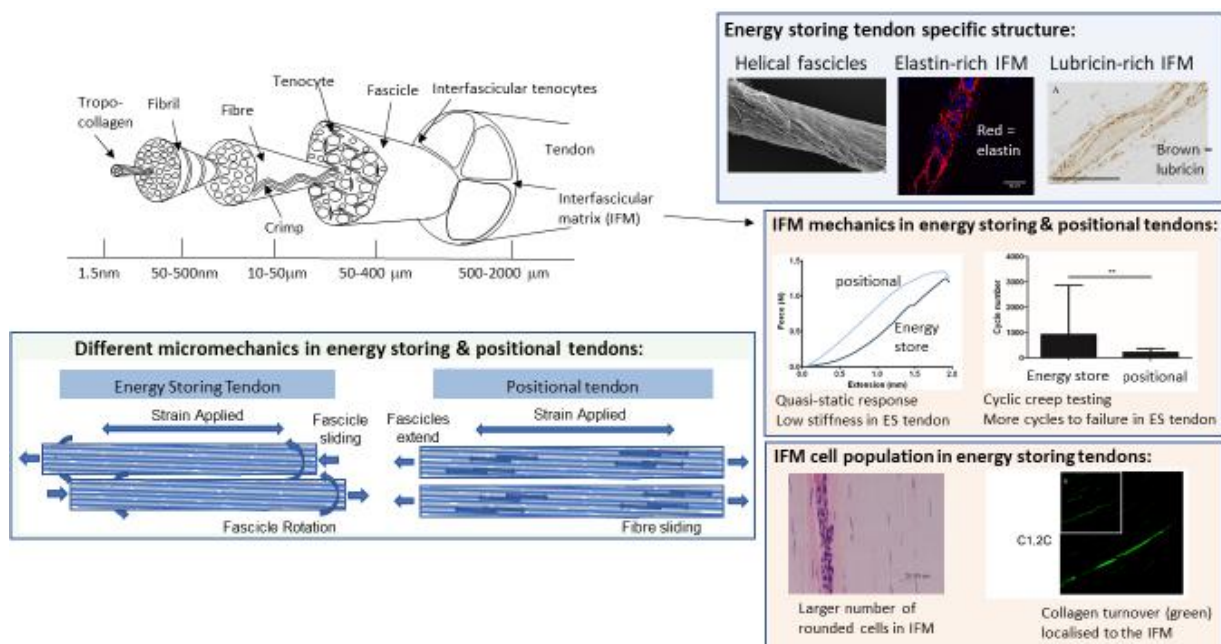
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The Achilles tendon facilitates locomotion by efficiently storing and releasing energy during loading cycles. Using in vitro approaches, we have been investigating the structure and mechanical behaviour of the Achilles and other energy storing tendons, utilising nano- to macro-scale techniques to establish the compositional and structural specialisms that enable energy storing tendons to carry out their functional role effectively.

We have identified a high degree of structural and mechanical specialism in the non-collagenous matrix between the fascicles, termed the interfascicular matrix (IFM). In energy storing tendons, the IFM is elastin- and lubricin-rich, facilitating sliding and recoil between fascicles during tendon loading [2-4] and providing less stiff, more fatigue resistant behaviour [5]. The IFM is highly cellular, and faster turnover of IFM proteins suggests that it is repaired and maintained at a faster rate. Further, we have demonstrated that the IFM is the first region of tendon to respond to overload damage, suggesting that injury may initiate in this region of the tendon.

It is well known that tendons from older individuals are more injury prone, so we have examined IFM behaviour in aged energy storing tendons, as a mechanism of providing further insight into the importance of IFM mechanobiology in tendon health. We have shown loss of the structural specialisation of the IFM with age, leading to reduced tendon fatigue resistance. We also see reduced turnover rate of the IFM suggesting less capacity for IFM renewal.

Taken together, our data indicate that the IFM is crucial for healthy tendon function, enabling fascicle slide and recoil as a tendon is loaded. The IFM is continually renewed to maintain healthy mechanics, and the cell population is active and mechanoresponsive. Under normal use, we hypothesise that tendon use generates microdamage and rapid repair predominantly within the IFM region of tendon, which is well equipped to manage the mechanical demands. However, in overuse situations, we anticipate that excess damage will initiate in the IFM of tendon, and early or prophylactic treatments should focus on this region. With ageing, stiffening occurs in the IFM specifically, meaning the risk of initiating this damage cycle is also increased [6,7].



## **Free communication session A1-A5**

### **A1: ACTIVITY INDUCED INCREASE IN ACHILLES TENDON BLOOD FLOW IS AGE AND GENDER DEPENDENT**

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**Background:** Previous research in a young adult population identified a lower increase in Achilles tendon blood flow immediately after a running activity as a significant predictor for the development of Achilles tendinopathy (AT). Furthermore, advancing age is often mentioned as a risk factor for the development of AT and the highest incidence for AT is reported to occur in middle-aged recreational male athletes.

**Purpose:** To investigate the effect of age, gender and type of physical activity on the increase in Achilles tendon blood flow.

**Methods:** Blood flow measurements of 33 subjects aged between 18 and 25 years and 30 subjects aged between 40 and 55 years were obtained before and after four different physical activities, performed in randomized order: running, cycling, dynamic stretching, and rope skipping. Blood flow measurements of the Achilles tendon were performed before, immediately after, 5 minutes after, and 10 min after the physical activities. The effect of age, gender and physical activities on the increase in blood flow was investigated with linear mixed models.

**Results:** Prominent was the finding that the increase in blood flow after activity is significantly lower in the older population compared to the younger population ( $p < 0.001$ ). Furthermore, male participants in the older age group showed a significant lower increase in tendon blood flow compared to their female counterparts ( $p = 0.019$ ).

**Conclusion:** This study identified that both gender and age significantly influence the increase in blood flow after activity, possibly explaining the increased risk for AT in middle-aged recreational athletes.

### **A2: INTRINSIC RECOVERY MECHANISMS IN RAT TAIL TENDON, THEIR LIMITATIONS AND THOSE OF THE MODEL SYSTEM**

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Among patients with musculoskeletal problems over a third suffers from tendon / ligament related conditions with tendinopathy being the most common one. The prime suspect for the onset of this painful condition is repetitive mechanical overloading resulting in accumulating micro-damage. It is unclear which potential intrinsic tendon healing mechanism possess to deal with this micro-damage and where their limits for recovering damaged tissues are.

We used rat tail tendon fascicles as a model for intrinsic healing and induced damage using a single-stretch, ramp-to-failure loading protocol. Damage infliction was verified through mechanical testing and collagen hybridizing peptide staining. Then, fascicles were cultured in a custom-built bioreactor for 7 days while monitoring changes in the elastic modulus and cellular behaviour. Already 4 hours after inflicting diffuse damage, we could observe a drop in cell viability from  $81 \pm 10\%$  to  $53 \pm 7\%$ , while the undamaged control group maintained its cell viability for 7 days ( $93 \pm 4\%$ ). Interestingly, rat tail tendon fascicles were nevertheless able to recover almost half of the loss in linear elastic modulus ( $43 \pm 10\%$ ) within 2 days even when subjected to multiple freeze-thaw cycles pre-damage. We were able to partially prevent this recovery by inhibiting the collagen-crosslinking enzyme lysyl oxidase using  $\beta$ -Aminopropionitrile.

In conclusion, it appears that tenocytes residing in the interfibrillar space are damaged during interfibrillar sliding caused by overstretching and are therefore unable to participate in an intrinsic healing response. Regardless, the pool of remaining collagen-crosslinking enzymes within the tissue seems to be able to partially recover losses in the mechanical properties.

### **A3: LIFE-LONG HABITUAL SIDE-SPECIFIC LOADING IS ASSOCIATED WITH REDUCED MECHANICAL STRESS IN THE OLDER PATELLAR TENDON**

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It remains unknown if life-long habitual side-specific loading results in augmented structural and mechanical properties of the older tendon. The purpose was to investigate if life-long side-specific loading ( $51 \pm 8$  playing-yrs) leads to greater cross-sectional area (CSA) and mechanical properties of the patellar tendon (PT) in 9 elderly ( $66 \pm 7$  yrs) knee injury free elite badminton players and fencers. CSA of the PT obtained by 3-tesla MRI and ultrasonography-based measurement of tibial and patellar movement together with PT force during isometric contractions were used to estimate mechanical properties of the PT bilaterally. The data show that the proximal

and distal, but not the mid PT tendon CSA of the lead extremity was greater than the non-lead extremity (Proximal:  $154 \pm 12 \text{ mm}^2$  vs.  $126 \pm 8 \text{ mm}^2$ , mid:  $130 \pm 10 \text{ mm}^2$  vs.  $113 \pm 4 \text{ mm}^2$  and distal:  $128 \pm 9 \text{ mm}^2$  vs.  $112 \pm 5 \text{ mm}^2$ ;  $p < 0.05$ ). For a given common force, the average stress (based on average CSA) was lower on the lead extremity ( $28 \pm 4 \text{ MPa}$ ) compared with the nonlead extremity ( $32 \pm 4$ ;  $P < 0.05$ ). However, PT stiffness did not differ between the lead extremity ( $4997 \pm 887 \text{ N/mm}$ ) and the nonlead extremity ( $4800 \pm 1016 \text{ N/mm}$ ). Moreover, there was no side-to-side difference for PT modulus (lead  $1.6 \pm 0.3 \text{ GPa}$  vs. nonlead  $1.8 \pm 0.3 \text{ GPa}$ ) at a common force. These data demonstrate that life-long unilateral habitual loading in elderly elite athletes yields region-specific tendon hypertrophy that may serve to lower the mechanical stress and thereby reduce the risk of injury.

#### **A4: DISORGANIZED MATRIX TOPOGRAPHY AND MECHANICAL LOAD MEDIATE MACROPHAGE INFLAMMATORY RESPONSE IN A TENDINOPATHY MODEL**

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Degenerated tendon tissue is characterized by a misalignment of the extracellular matrix, which causes morphological changes in the resident cell population and altered loading patterns. The resulting higher strain levels in the tissue together with the infiltration of immune cells have been hypothesized to play a critical role in tendon healing. In the present study we analyse the effect of mechanical load on the crosstalk between macrophages and tendon fibroblasts (TFs) using an *in vitro* approach. Primary human TFs and naïve macrophages were cultured on aligned or random oriented nanofiber substrates (modelling ‘healthy’ and ‘diseased’ tissue, respectively) and secured within a custom-made bioreactor for conditioning by either static load (0% strain) or cyclic overloading (7% strain) for 24h. Our results reveal that disorganized topographies initiate polarization of naïve macrophages towards an inflammatory phenotype, which is further enhanced due to cyclic mechanical loading ( $p = 0.0069$ ). Quantitative evaluation of cytoplasmic and nuclear levels of NFκB-p65 subunit in TF by fluorescent staining, indicates that cyclic overload significantly increases p65 nuclear translocation in TFs adhering to both substrate topographies, being however the response on the randomly oriented fibers more pronounced ( $p < 0.0001$ ). TFs exposed to cyclic overload display reduced p65 nuclear-translocation when stimulated with IL-1β compared to those cells statically loaded ( $p = 0.0037$ ). This might be explained by the initially higher amount of nuclear p65 in these cells, indicative of a ‘pre-activated’ state. Taken together, we show that matrix alignment and cyclic mechanical loading cooperatively mediate TF response to pro-inflammatory stimuli.

#### **A5: IDENTIFICATION OF SUSCEPTIBILITY LOCI FOR MUSCULOSKELETAL SOFT TISSUE INJURIES USING A BIOLOGICAL NETWORK MAPPING STRATEGY**

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**Introduction:** Musculoskeletal (MSK) injuries are common. Several genetic loci have been implicated. This study aimed to develop a “machine learning” approach to improve identification of “risk” genes. Bioinformatic tools were used to find new information through assessing the feasibility and performance of the BioOntological-Relationship-Graph-database (BORG) to identify tendon, ligament and inflammatory related components to Achilles tendinopathy and anterior cruciate ligament ruptures (ACL).

**Subjects and methods:** All known human genes and whole exome sequencing (WES) genes identified in our lab were screened through BORG to identify genes and loci. Prioritised genes were explored in an ACL cohort; controls (CON=232), cases (ACL= 237), NON- contact cases (NON=137).

**Results:** Screening all genes through BORG (~3500 genes) and WES data (~415 genes) were linked to tendinopathy and ACL. Fifty-four genes were prioritised. Two variants in *heparin sulphate proteoglycan 2: HSPG2* (rs2291826 A/G, rs2291827 G/A) were explored. The rs2291826 G/G (GG VS A/G+AA) genotype was under-represented in CON (CON=2%; ACL=14%;  $p < 0.001$ ; OR:1.13 95% CI: 0.75-1.71) and NON sub-group (CON=2%; NON=9%;  $p < 0.01$ ; OR:1.08; 95% CI: 0.68-1.70) when males were compared. The rs2291827 A/A (AA VS G/A+GG) genotype was over-represented in CON (CON=7%; ACL=0%;  $p = 0.02$ , OR; 0.45 95% CI: 0.19-0.97) and similarly the A allele was over-represented in CON (CON=22%; ACL=13%;  $p < 0.001$ ; OR:0.45 95% CI:0.25-0.77) when females were compared.

**Conclusion:** We propose that this BORG tool together with WES sequencing data be collectively used in a genomics approach for MSK injuries.

## **Keynote 2 – Imaging of Tendons: New Developments**

**Dr. Edwin H.G. Oei, MD, PhD, Erasmus MC Rotterdam, The Netherlands**

This keynote lecture will provide an overview of current and novel imaging techniques for the assessment of tendon derangements, focusing on magnetic resonance imaging (MRI) and ultrasound. We will begin the lecture by revisiting more traditional and clinically established MRI and ultrasound techniques and assessment criteria for pathology. With regard to MRI a typical clinical imaging protocol consists of a combination of proton density and T2-weighted images in multiple planes and examples of the complementary value of each imaging sequence is illustrated. In ultrasound, gray-scale imaging to assess tendon morphology and structure is typically complemented by an evaluation of tendon vascularization with the use of power Doppler ultrasonography.

The majority of the lecture will cover new developments in MRI and ultrasound that enable a more accurate assessment of tendinopathy. New generation MRI and ultrasound hardware and software enable the visualization of tendinous tissue with high spatial resolution. In addition, there is a general trend in radiology towards developing and applying more quantitative imaging methods to characterize tissue changes as an adjunct to visual assessment. The purpose of quantitative imaging is to provide more objective, numeric, measures of disease status, otherwise referred to “imaging biomarkers”. These imaging biomarkers may serve as outcomes to monitor disease status in therapeutic trials. Quantitative imaging techniques may also facilitate the detection of diseases such as tendinopathy at earlier stages when subtle yet measurable tissue alterations precede morphological changes or frank signal abnormalities.

In the field of musculoskeletal MRI, ultrashort echo time (UTE) MRI refers to a novel promising quantitative MRI technique that enables the detection and quantification of signal, and alterations thereof, in tissues that typically exhibit low signal on regular MRI sequences due to the relatively low water content, such as tendons. Normal water content in unaffected tendons as well as increased water content in case of tendinopathy can be determined quantitatively with UTE MRI and when this is calculated per voxel, the result can be displayed spatially in a (T2\*) map.

In ultrasound, elastography constitutes a novel method to assess the elasticity (or stiffness) of tissue. There is an increasing body of literature applying shear wave elastography to musculoskeletal tissues such as tendon, since it is expected that tendon elasticity may provide useful information in addition to assessment of morphology and vascularity.

We will also touch upon important challenges associated with the development and validation of new quantitative imaging techniques, as well as a step-wise approach in introducing novel imaging biomarkers. This includes the assessment of inter- and intra-observer reliability, reproducibility and validation against tissue references and clinical endpoints.

### **References**

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- Coombes BK, Tucker K, Vicenzino B, Vuvan V, Mellor R, Heales L, Nordez A, Hug F. Achilles and patellar tendinopathy display opposite changes in elastic properties: A shear wave elastography study. *Scand J Med Sci Sports.* 2017 Oct 3.

## **Free communication session B6-B10**

### **B6: NON-UNIFORM DEFORMATION IN ACHILLES TENDON NOT INFLUENCED BY KNEE ANGLE OR LEVEL OF FORCE PRODUCTION**

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#### **Background**

Mechanical loading has become the golden standard in managing Achilles tendinopathy. The goal of this study was to evaluate the impact of different levels of force production and knee angle on the non-uniform behaviour in the Achilles tendon during an isometric contraction. It was hypothesized that a flexed knee position would lead to a more non-uniform behaviour, due to greater differential loading of soleus versus gastrocnemius in this position, but that this effect would be attenuated by higher levels of force production.

#### **Methods**

Nineteen healthy subjects participated. A high-spatial and high-temporal resolution US system was used to acquire 2D + time ultrasound images during an isometric contraction at 25%, 50% and 75% MVC in the extended and flexed knee position. Local tendon tissue displacement and normalized displacement ratio of the different tendon layers were calculated.

#### Results

It was found that the non-uniform deformation, i.e. superficial-to-deep variation in displacement with highest displacement in the deep layer, is consistently present, irrespective of the level of force production and knee angle.

#### Conclusion

From clinical perspective, this might indicate the absence of a mechanical rationale for a change in knee angle during eccentric heel drops. Additionally, it was found that despite reaching high levels of force, the contribution of the Achilles tendon might be relatively small, potentially due to compensatory actions. This is relevant for rehabilitation as the goal is to reach local tendon loading. Therefore, the tool used in this study might be ideally placed to monitor local loading during rehabilitation.

### **B7: SHEAR WAVE ELASTOGRAPHY DEMONSTRATES REDUCED PATELLAR TENDON ELASTICITY IN JUMPING ATHLETES WITH PATELLAR TENDINOPATHY**

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**PURPOSE**-Patellar tendinopathy (PT) is characterized by localized patellar tendon pain and decreased performance in athletes. Morphologic changes and neovascularization are sequelae of PT, however sometimes subtle or absent. Evaluating elastic properties of the patellar tendon could improve the sonographic diagnosis of PT. Shear wave elastography (SWE) is a quantitative ultrasound-based imaging method measuring tissue elasticity. To explore the diagnostic performance of SWE to visualize PT, we evaluated patellar tendon elasticity in athletes with PT compared to activity-matched healthy jumping athletes.

**METHODS**-Athletes aged 18-30 years, playing tendon-loading sports at least 3 times per week were included for clinical and radiological evaluation of the patellar tendon. Symptomatic athletes underwent clinical examination and conventional ultrasound to confirm the diagnosis of PT. Activity-matched healthy controls without history of knee pain were recruited for ultrasound of both knees. Primary outcome was mean elastic modulus of the proximal patellar tendon measured in kilopascal (kPa). Tendon thickness was a secondary outcome measure. Linear regression analysis was performed to determine the association between tendon thickness and elasticity.

**RESULTS**-We included 37 athletes (30 affected with PT). Median elastic modulus of the proximal patellar tendon was 76.5 kPa [IQR 59.2-106.9] in PT, compared to 35.4 kPa [IQR 31.9-42.3] in healthy controls ( $p<0.001$ ). Increased tendon thickness was associated with reduced tendon elasticity in jumping athletes with PT after adjustments for age and sex,  $\beta=9.7$  (95%CI 5.5-13.8),  $p<0.001$ .

**CONCLUSION**-Patellar tendon elasticity is reduced in jumping athletes with patellar tendinopathy compared to activity-matched controls. Furthermore, tendon elasticity is associated with tendon thickness.

### **B8: SIX-WEEKS OF INTENSIVE REHEARSALS PRIOR TO SWAN LAKE, SHOWS STRUCTURAL CHANGES OF THE ACHILLES TENDONS IN BALLET DANCERS**

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#### Objectives

To study whether six weeks of intensive dance exposure (Swan Lake rehearsals) is a contributor to structural changes, symptoms, clinical signs and Achilles tendon (AT) pain.

#### Methods

All ballet dancers from The Royal Danish Ballet Company (aged 18-41) were invited (n=79) and sixty-three (80%) dancers participated. Baseline scans were collected with follow-up scans at six weeks. The primary outcome was quantification of AT structure with Ultrasound Tissue Characterisation (UTC) (echo-type I-IV, type I: intact and aligned fibres, type II: less continuous fibres and wavy bundles, type III: highly variable, mainly smaller fibres and type IV: amorphous tissue containing cells and/or fluid). Secondary outcomes were clinical signs and symptoms from; a clinical examination, self-reported symptoms, VISA-A questionnaire and pain during single-legged heel raise. UTC has previously shown satisfactory reproducibility and validity. Multilevel linear and logistic regression models included time and demographic variables as covariates.

#### Results

From baseline to follow-up there was significant decrease in the distribution of UTC echo-type I ( $\beta=-3.6$ ,  $p=0.001$ ; 95% CI: -5.8;-1.5) with significant increase in echo-type II ( $\beta=3.2$ ,  $p<0.0001$ , 95% CI: 1.6;4.8). Significant effects were also seen, of limb (type I and III) and gender (type I and II). No significant changes were found in secondary outcomes.

#### Conclusion

The cohort of ballet dancers showed significant UTC changes, mainly a reduction of echo-type I distribution after six-weeks pre-season period rehearsing the Swan Lake. Since no changes were found in clinical outcomes, early structural changes seem important to follow longitudinally for planning secondary prevention strategies.

#### **B9: AXIAL STRAIN ELASTOGRAPHY IN YOUTH BASKETBALL PLAYERS WITH PATELLAR TENDINOPATHY**

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**Purpose:** To evaluate the diagnostic accuracy of axial strain elastography compared with axial strain elastography for the diagnosis of patellar tendinopathy (PTP) in youth basketball players.

**Methods:** A nested case-control study within a larger prospective cohort study. Twenty-two players (ages 13-18 years; 21.7% females) with a clinical diagnosis of PTP and 22 matched controls were recruited during the 2016-2017 high school and 2017 club basketball season in Calgary. Subjects were diagnosed by a sports medicine physician and/or physiotherapist and underwent a sonographic assessment of bilateral patellar tendons by a medical sonographer and a fellowship-trained musculoskeletal radiologist, both blinded to case-control status of the study participants (PTP unilateral, bilateral, no PTP). Using a graduated colour strain, the axial strain elastograms of the proximal tendon was recorded on a 100-point continuous visual analog scale (VAS), using red "0" (soft) and blue "100" (hard). Tendon stiffness based upon the VAS were stratified as hard/elastic (67-100), intermediate (34-66), and soft/less elastic (0-33). The soft and intermediate categories were considered "pathological tendon" and hard considered "non-pathological tendon." Accuracy, sensitivity, and specificity (with 95%CI) were calculated.

**Results:** Accuracy of axial strain elastography in comparison with clinical evaluation was 83% (95%CI: 72%-90%); sensitivity was 87% (95%CI: 71%-95%) and specificity 21% (95%CI: 10%-37%).

**Conclusions:** Axial strain elastography is a sensitive but not a specific measure of patellar tendon pain.

**Acknowledgments:** This study was funded by the National Basketball Association and General Electric Healthcare through the Orthopedics and Sports Medicine Collaboration Grant on Tendinopathy.

#### **B10: SCREENING ELITE RUGBY PLAYERS WITH UTC YIELDS USEFUL IN-SEASON INJURY RISK INFORMATION: A COHORT STUDY**

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Introduction:

B-mode ultrasound abnormalities predict higher future Achilles symptom risk, so we aimed to determine whether pre-season ultrasound tissue characterisation (UTC) screening predicted in-season time-loss from Achilles tendon pain.

Methods:

223 elite rugby players had bilateral pre-season UTC scans and symptom history recording. Tendon alignment was semi-quantified into 4 echotypes defined by structural homogeneity. Injury surveillance by medical staff defined Achilles pain from missing  $\geq 1$  training session.

Results:

16 injuries were reported. Cox regression analysis revealed a UTC type IV hazard ratio (HR) of 1.356 (95% CI=1.16-1.59), and 1.095 (1.04-1.15) for summed III and IV grades. Including Achilles injury history reduced HR values to 1.203 (1.00-1.44) and 1.056 (0.99-1.12) for grade IV and the sum of grades III and IV, respectively. Using an 8% threshold for combined III and IV grades, determined as optimal through sensitivity analysis, revealed a relative injury risk of 4.53 (1.7-11.8), with a sensitivity of 0.56 and specificity of 0.79. Adding history of injury increased the relative risk to 10.48 (4.2-26.4) with a specificity of 0.96, but decreased sensitivity to 0.38.

Conclusion:

Screening with UTC provides useful information about injury risk. The inclusion of injury history improves specificity but reduces sensitivity and suggests UTC and injury history are associated. These promising results mean UTC screening should be considered but the low sensitivity and high expense means careful pre-implementation decisions about cost-benefit are needed.

### **Free communication session C11-C15**

#### **C11: DOES TENDON STRUCTURE CORRELATES WITH CLINICAL STATUS AFTER CONSERVATIVE TREATMENT IN PATIENTS WITH ACHILLES/PATELLAR TENDINOPATHY?**

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Introduction: In tendinopathy, the relation between clinical and structural changes still remains controversial. More research is necessary to investigate this relation using new imaging techniques, like Ultrasound Tissue Characterization (UTC) – which objectively quantifies tendon organization. The aim of this study is to investigate changes after treatment compared to baseline in clinical and imaging outcomes, and their relation, in patients diagnosed with Achilles (AT) or patellar tendinopathy (PT).

Methods: A total of 38 patients (19 midportion AT and 19 PT) with unilateral symptoms were included. During the follow-up period patients performed different conservative treatments (eg. education/pain management, loading exercise, EWST). To measure clinical status the patient-reported Victorian Institute of Sports Assessment (VISA)

questionnaire was used. Tendon structure was assessed using the UTC, which divides the structure in four different echo-types. Patients were assessed at their first visit and a follow-up visit (ranging from three to 12 months).

Results: For the midportion AT group, there was a significant improvement in tendon structure (echo-type I increased and type III decreased) with a significant improvement in the VISA-A score. For the PT group, echo-type IV decreased significantly, without significant change on the VISA-P score. A significant negative correlation ( $-0.53$ ,  $p=0.026$ ) between echo-type II and VISA-A score was observed. No correlations were observed between echo-types I-IV and VISA-P score.

Conclusion: The UTC showed significant changes in tendon structure as a result of the conservative treatment. However, those changes demonstrated poor (AT) or no (PT) correlation with the changes in the clinical status (VISA score).

## **C12: USING MYOMETRIC MEASUREMENTS TO ASSESS STIFFNESS OF TENDINOPATHIC ACHILLES TENDONS**

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### **Introduction (purpose / background):**

Myometric measurements (MM) are increasingly used to assess the mechanical properties of healthy Achilles tendons (AT). Since mechanical properties alter with Achilles tendinopathy, MM could potentially be used to monitor therapeutic interventions. As a first step towards this application, MM must be capable of measuring alterations in mechanical properties which should be most obvious in patients with unilateral tendinopathy.

Therefore, we assume that MM will detect a lower stiffness of the tendinopathic tendon in patients with unilateral tendinopathy.

### **Methods:**

Stiffness (N/m) of both legs' free AT and aponeuroses of 12 patients with unilateral Achilles tendinopathy ( $43 \pm 10$  yrs,  $181 \pm 4$  cm,  $83 \pm 11$  kg) were measured with the MyotonPRO (Myoton AS, Estonia). Their ankles were positioned at 20 degrees plantar flexion to minimize the influence of muscle tension. The measurements took place from September 2017 to March 2018, and 12 additional patients will be measured until July.

### **Results:**

The tendinopathic AT was 9.1 % less stiff compared to the healthy side (748 vs. 823 N/m,  $p=0.02$ ). No side difference was found for the aponeuroses (671 vs. 674 N/m,  $p>0.05$ ).

### **Conclusions/Discussion:**

According to the preliminary results of the ongoing study, myometric measurements seem to be able to uncover lower tendon stiffness in patients with unilateral Achilles tendinopathy. This is in agreement with previous studies that used ultrasound. Identifying side differences using MM in patients with Achilles tendinopathy could be relevant for real-time monitoring and quantification of future interventions with a mobile and easy-to-use device.

## **C13: PLYOMETRIC EXERCISE INDUCES GREATER ACHILLES TENDON RESPONSE THAN TREADMILL RUNNING: A RANDOMISED CROSS-OVER UTC STUDY**

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**Background / aim:** This study investigated (1) whether objective ultrasound imaging (Ultrasound Tissue Characterisation, UTC) could detect structural changes in Achilles tendons after a bout of exercise and (2) whether tendon responses differ between plyometric exercise (PLYO) and treadmill running (TM).

**Methods:** Eleven healthy volunteers (male  $n=9$ , mean age  $24.5 \pm 3.9$  years) undertook a 20-minute heart rate-standardised (65-75% max-HR) bout of PLYO and TM, one week apart in a randomised cross-over study design. Achilles tendons were imaged and analysed using UTC prior to each exercise, and at day-2, 4, and 7 post-exercise. Physical activity prior to and during the study was controlled to minimise confounding variables.

**Results:** UTC was able to detect significant exercise-related changes in both PLYO and TM, with mean increase in ET2 (PLYO  $3.7\% \pm 4.4$ ; TM  $2.6\% \pm 3$ ) and ET3+4 (PLYO  $3.7\% \pm 4.6$ ; TM  $2.2\% \pm 3.2$ ). The PLYO protocol exhibited significantly greater ET2 and ET3+4 increase at day-2 in both the insertional ( $2.6\%$ ,  $p=0.007$  and  $3.6\%$ ,  $p<0.001$  respectively) and non-insertional Achilles regions ( $4.8\%$ ,  $p<0.001$  and  $3.6\%$ ,  $p=0.008$  respectively) compared with the TM protocol. Day-4 and -7 ET2 and ET3+4 changes demonstrated a return to baseline in both groups.

**Conclusion:** This study shows tendon structure changes in response to acute exercise and is detectable by objective changes on UTC. Furthermore, plyometric exercise appears to exert a greater mechano-transductive effect on the Achilles tendon. This may have implications for monitoring training load, training type, and running style, in efforts to prevent and manage Achilles Tendinopathy.



#### **C14: DOES IN VIVO MECHANICAL LOADING OF THE TIBIA AFFECTS THE ACHILLES TENDON IN MICE?**

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Although it is well known that mechanical loading of tendon is essential for tissue homeostasis and function, the underlying mechanism of tendon mechanobiology remains unclear. Therefore, the present study aims to determine the suitability of an established *in vivo* tibial loading model to study tendon mechanobiology.

The left tibiae of ten-week old female BALB/c mice (n=14) were subjected to axial cyclic compressive loading for three weeks (5 days/week) and the right tibiae served as the non-loaded control. Achilles tendons were investigated on the histological (n=8) and molecular level (n=6).

Histological analysis of Hematoxylin&Eosin staining revealed no significant difference in cell size, number or morphology between the loaded and non-loaded Achilles tendons. In-depth analysis of Sirius Red staining showed no significant difference in fiber anisotropy or angle distribution of the fibers. Interestingly, the gene expression analysis revealed significant differences: the levels of Collagen type I (Col1) and III (Col3), Elastin and Matrix metalloprotease 2 (MMP2) were higher in the loaded Achilles tendons compared to the non-loaded controls.

This study showed for the first time that a set-up used for *in vivo* bone loading induced changes on the molecular level in tendons without altering the tendon structure. The significantly increased levels of Col1, Col3 and MMP2 imply extracellular matrix turnover, while, they were not dramatic enough to induce histologically visible degeneration. This set-up allows the investigation of mechanical loading to further study tendon mechanobiology contributing to the development of rehabilitation programs.

#### **C15: DIABETIC ACHILLES TENDONS ARE THICKER AND DISPLAY ABNORMAL SHEARWAVE ELASTOGRAPHIC FINDINGS**

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##### **Introduction**

Ultrasound and shearwave elastography may provide complementary clinical information about tendon health. This preliminary study aimed to determine the effect of diabetes on Achilles tendon morphological and material properties and calf muscle function.

##### **Methods**

33 sedentary adults with type two diabetes and 7 control participants (matched for age, body mass index and physical activity) underwent bilateral Achilles tendon assessment (n=80 tendons). Tendon thickness, subcutaneous fat thickness, shear wave velocity (SWV, an index of shear modulus) and void (an elastography artefact) were measured by Aixplorer Ultrasound Scanner in prone (resting ankle angle measured by goniometer). Single leg calf raises were repeated until pain onset. Diabetes and control groups were compared using t tests with unequal variance. Exploratory subgroup analysis compared diabetic tendons with thickness above and below normative threshold of 6.4mm.

##### **Results**

Compared to control tendons, Achilles tendons from diabetic participants had greater thickness, subcutaneous fat and void (all p<0.01), but no differences in SWV (p=0.86). All 14 control tendons and 52 (79%) diabetic tendons displayed normal thickness. Within the diabetes group, enlarged tendons displayed lower SWV (p<0.01) and greater void (p=0.02), and fewer calf raises were performed on this side (p=0.02). Resting angle was more dorsiflexed in diabetic than control tendons, and in diabetic tendons with thickness above than below 6.4mm (p<0.01).

##### **Discussion**

Diabetes is associated with increased thickness of the Achilles tendon. Enlarged diabetic tendons showed lower SWV that might be interpreted as lower shear modulus and was associated with poorer calf muscle function.

### **Keynote 3 - Metabolic Disease & Tendon Disorders**

**Dr. Michele Abate, Department of Medicine and Science of Aging, University G. d'Annunzio, Chieti-Pescara, Chieti Scalo, Italy**

Metabolic disorders are of paramount relevance to the onset and progression of tendon damage. Indeed, clinical and experimental research shows that diabetes, obesity and, to a lesser extent, hypercholesterolaemia, hyperuricaemia and some rare congenital metabolism disorders (alkaptonuria, glucose-6-phosphatase deficiency and hypergalactosaemia) are frequently associated with tendon degeneration, thus influencing the mechanical properties of tendons and even impairing the healing process after surgery.

The aim of this paper is to report the present knowledge on this topic and to analyse the mechanisms for the negative effects of these metabolic disorders.

In diabetes, the prevalence of rheumatological diseases is high, mainly because of the deleterious effects of advanced glycation end products that deteriorate the biological and mechanical functions of tendons and ligaments. In heterozygous familial hypercholesterolaemia, most patients develop Achilles xanthomatosis, a marker of high risk for cardiovascular disease caused by cholesterol deposition in the tendons. Tendon degeneration has also been observed in non-familial hypercholesterolaemia. Monosodium urate crystal depositions in soft tissues are hallmarks of chronic gouty arthritis. In this group of diseases, the mobilization of cholesterol and uric acid crystals is presumably followed by low-grade inflammation, which is responsible for tendon degeneration. Moreover, adiposity may contribute to tendon disorders via two different mechanisms: increased weight on the load-bearing tendons and systemic dysmetabolic factors that trigger subclinical persistent inflammation. Finally, tendon abnormalities have been observed in some rare congenital metabolism disorders such as alkaptonuria.

In conclusion ample evidence shows that metabolic disorders have deleterious effects on tendons and favour tendon degeneration. This must be taken into account in the diagnosis and treatment of this disorder.

### **Free communication session D16-D20**

#### **D16: EXPERIMENTAL DIABETES ALTERS THE MORPHOLOGY AND NANO-STRUCTURE OF THE ACHILLES TENDON**

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Introduction: Although of several studies that associate chronic hyperglycemia with tendinopathy, the connection between morphometric changes as witnessed by nanostructural changes, and inflammatory markers have not yet been fully established. Therefore, the present study has as a hypothesis that the Achilles tendons of rats with diabetes mellitus (DM) exhibit structural changes. Methods: The animals were randomly divided into two experimental groups: Control Group (06) injected with a vehicle (sodium citrate buffer solution) and Diabetic Group (06) consisting of rats submitted to intraperitoneal administration of streptozotocin. Morphology of the collagen fibers within tendons was examined using Atomic Force microscopy (AFM) and magnetic resonance. Results: An increase in the dimension of the coronal plane area was observed in the diabetic group ( $8.583 \pm 0.646$  mm<sup>2</sup>/100g) when compared to the control group ( $4.823 \pm 0.267$  mm<sup>2</sup>/100g) resulting in a significant difference ( $p=0.003$ ) upon evaluating the Achilles tendons. Similarly, our analysis found an increase in the size of the transverse section area in the diabetic group ( $1.328 \pm 0.103$  mm<sup>2</sup>/100g) in comparison to the control group ( $0.940 \pm 0.01$  mm<sup>2</sup>/100g)  $p=0.021$ . The tendons of the diabetic group showed great irregularity in fiber bundles, including modified grain direction and jagged junctions and deformities in the form of collagen fibrils bulges. Despite the morphological changes observed in the Achilles tendon of diabetic animals, IL1 and TNF- $\alpha$  did not change. Conclusions: Our results suggest that DM promotes changes to the Achilles tendon with important structural modifications as seen by AFM and MR, excluding major inflammatory changes.

#### **D17: GLUCOCORTICOID EXPOSURE MAY EXPLAIN THE ASSOCIATION BETWEEN METABOLIC DYSFUNCTION AND TENDINOPATHY**

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**Background**Metabolic health affects connective tissue structure and function. However, the mechanisms linking metabolic health to increased rates of tendon dysfunction and rupture are unclear.

Glucocorticoid hormones such as cortisol are present in almost every cell type in the body and play a key role in a raft of key physiological processes. These include the stress response, energy homeostasis, inflammatory and immune processes, and cardiovascular function.

**Objective**To synthesise current knowledge linking glucocorticoids exposure to tendon structure and function.

**Methods**Narrative literature review.

**Results**The review covers the key areas of visceral adiposity, dyslipidaemia, insulin resistance and type 2 diabetes, the sympathetic nervous system, and Cushing's syndrome. In these areas, we highlight the role of glucocorticoids and how these hormones might underpin the connection between metabolic health and tendon dysfunction.

**Conclusions**There are several plausible pathways through which glucocorticoids might mediate the connection between metabolic health and tendinopathy. We discuss the overlap between metabolic features associated with tendinopathy and glucocorticoid excess, and propose future research directions.

#### **D18: SCREEN'EM BEFORE YOU TREAT'EM A CLINICAL TOOL TO HELP IDENTIFY SPONDYLOARTHROPATHY IN PATIENTS WITH TENDINOPATHY**

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##### **Introduction:**

The majority of tendinopathies are insertional and affect the enthesis. Enthesitis is present in all subtypes of Spondyloarthropathy (SpA). Screening for SpA should be an essential component of assessment when seeing patients with tendon pain. Early recognition is essential in SpA, as delay to diagnosis may lead to irreversible joint damage. The purpose of this paper is to present a clinical tool which was designed to assist clinicians in the recognition of patients who present with tendon pain which may be as a result SpA.

##### **Methods:**

A clinical tool was designed based on clinical characteristics of SpA, to prompt the clinician to ask specific questions which may help identify patients who present with tendon pain that may be a result of SpA.

The tool is called SCREENDEM. The clinician should ask about the following during assessment of patients who present with tendon pain.

**Skin** - rash or psoriasis?

**Colitis or Crohns?**

**Relatives** – family history of inflammatory arthritis?

**Early Morning Stiffness?**

**Eyes** – has the patient had Uveitis?

**Nail involvement?**

**Dactylitis?**

**Enthesopathy?**

**Medication and Movement response?**

##### **Results/Conclusion:**

This tool has been used successfully in clinical practice for approximately 3 years. It is important to emphasise that this is not a diagnostic tool but a clinical tool to aid in identifying certain clinical traits and presentations that are associated with SpA. The authors suggest incorporating these questions as part of a routine clinical examination. If appropriate, onward referral and further testing should be performed to confirm or refute the diagnosis.

#### **D19: DANGER SIGNALLING IN TENDINOPATHY: A VITAL ROLE FOR HMGB1**

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Inflammatory mediators are increasingly implicated as driving matrix remodelling in tendinopathy. Alarmin proteins, such as Interleukin-33, are pivotal in the transition from type I collagen (Col1) to type III collagen (Col3) synthesis<sup>1</sup>. We sought evidence of another alarmin protein, high-mobility group box 1 (HMGB1), expression in human tendinopathy and its role in regulating inflammatory and matrix remodelling processes.

Tendon biopsies were collected from patients undergoing arthroscopic shoulder surgery and primary human

tenocytes were cultured from normal hamstring tendon. HMGB1 expression in tissue and the *in vitro* effect of HMGB1 on tenocytes was measured using ELISA, immunohistochemistry and quantitative RT-PCR. The role of Toll-like-receptor-4 (TLR4) in HMGB1 signalling was investigated using a specific siRNA against TLR4.

Tendinopathic tissues demonstrated increased presence of HMGB1 compared to control. This expression was greater in early disease compared with established disease pathology. Recombinant human HMGB1 led to significant increase in expression of a number of inflammatory mediators as well as genes involved in matrix remodelling. Interestingly, no change in Col1 expression was observed. In addition, knockdown of TLR4 abrogated the effects of HMGB1 on human tenocytes.

This study demonstrates the critical role of HMGB1 in inflammatory and matrix remodelling processes within early tendon disease. Effective targeting of receptors involved in the HMGB1 signalling pathway may offer novel therapeutic approaches in the management of a debilitating disease that currently has very limited treatment options.

#### REFERENCES

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#### D20: ADVANCED GLYCATION END-PRODUCT INDUCED MITOCHONDRIAL DYSFUNCTION IN TENOCYTES

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Debilitating cases of tendon pain and degeneration affects nearly 90% of patients with diabetes. The high rate of tendon degeneration persists even when glucose levels are well controlled, suggesting that other mechanisms may drive tendon degeneration in diabetic patients. We propose that advanced glycation end-products (AGEs), which are elevated in serum of diabetic patients, induce tendon degeneration. Specifically, in other models, AGEs active cellular pathways that lead to impairments in mitochondrial function and cell death but to our knowledge, the impact of AGEs on tenocyte mitochondrial function has not been previously evaluated. For this study, Achilles tenocytes were isolated from male rats and cultured in 5.5mM (LG) and 25mM (HG) glucose medium and treated with glycated albumin (AGE-BSA; 0, 50, 100 and 200 ug/ml) for 48 hours. Basal cellular respiration and mitochondrial function tests were completed on an Agilent XFp analyzer. Cell viability and death was quantified by propidium iodide and flow cytometry. Cell proliferation was assessed by fluorescent detection of synthetic thymidine nucleoside (EdU). Basal and mitochondrial respiration were reduced in the LG-100 (38.8%), HG-100 (57.8%), and HG-200 (75%) groups when compared to LG-0 ( $p < 0.05$ ). Glucose levels and AGE treatment did not alter cell death or cell proliferation ( $p > 0.05$ ), however, reduced metabolic activity was observed in all HG groups when compared to LG groups ( $p < 0.05$ ). Based on this initial work, AGEs appear to modulate cellular respiration and mitochondrial function independent of glucose levels, suggesting that simply controlling blood glucose may not prevent the development of tendinopathies in diabetic patients.

#### Session Tendon Pain

#### Keynote 4 - Tendons can be a pain

Dr. Ebonie Rio, Australia

Tendon pain is somewhat of an enigma. We lack gold standard tests for diagnostic confirmation, such as the ACL deficient knee that can be confirmed with imaging and in surgery. More and more studies present data on asymptomatic tendon pathology and many clinical tests aggravate multiple nociceptively competent structures, that is our pain provocation tests are likely to irritate people with different clinical phenotypes. We have many treatment approaches indicating again, no clear treatment path to recommend. There is no doubt diagnosing, treating and indeed experiencing tendon pain is challenging and this frustration is shared by patients, clinicians and researchers. These challenges also stem from the broad range of people affected by tendinopathy from young athletic people, to sedentary people with systematic disease. This leaves us with several questions for both clinicians and researchers including: who is a typical patient with tendinopathy, and how does the literature apply to the person in front of me? To approach these questions, we will examine the baseline features described in tendinopathy studies to define tendinopathy cases and controls, as well as consider common clinical presentations that are frequently excluded from our research studies. For example, the patient who has had multiple injection therapies who presents for management, or people with co-morbidities. How we apply the research to the person in front of us needs to take into consideration the patients baseline features (including beliefs), short and long-term goals. The emerging evidence for education in tendinopathy will be presented. In summary, the aim is to address common clinical questions around tendon pain (drivers,

links with imaging, central manifestations) with an evidence-based approach, and critically, consideration of individual factors.

## **Free communication session E21-E25**

### **E21: PRELIMINARY FINDINGS OF A CROSS-SECTIONAL STUDY OF SENSORY, PHYSICAL AND PSYCHOSOCIAL FEATURES IN GLUTEAL TENDINOPATHY**

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#### **Introduction**

Gluteal tendinopathy (GT) is a prevalent lower limb tendinopathy and is associated with poor quality of life. Profound disability and physical impairments have been reported, yet our understanding of the cardinal symptom, lateral hip pain, remains unexplored. We studied sensory, physical and psychosocial characteristics in GT compared to healthy controls (HC).

#### **Methods**

This cross-sectional study compared 29 GT participants (93% female, mean age 51 years, mean BMI 27.0kg/m<sup>2</sup>) with a mean duration of symptoms of 18 (range 3-48) months compared with 58 sex and age matched HC (95% female, 53 years, BMI 24.0kg/m<sup>2</sup>). Conditioned pain modulation (CPM), temporal summation and pain threshold tests for pressure (PPT), heat (HPT) and cold (CPT) locally (greater trochanter) and remotely (lateral epicondyle); isometric hip abduction and extension torque (affected limb), functional tests and self-reported psychosocial measures were assessed. A MANOVA was performed to compare groups. Standardised mean differences (SMD) were computed to represent effect size.

#### **Results**

Large effects (SMD>1.2, p<0.01) were observed on the 20m walk test and locally measured PPT, moderate effects (SMD 0.6-1.2, p<0.01) on CPM, hip abductor torque, anxiety and depression and small effects (SMD 0.2-0.6, p<0.05) on remote measures of PPT, CPT and hip extensor torque. Data collection is ongoing and will be updated at conference.

#### **Conclusion**

GT participants display marked hip abductor weakness and local hyperalgesia compared to HC. Although smaller in effect, the presence of widespread mechanical and thermal hyperalgesia along with likely less efficient inhibitory processing, suggests more complex central nervous system pathways are also involved.

### **E22: STRUCTURAL, FUNCTIONAL, AND SYMPTOMATIC DIFFERENCES IN PATIENTS WITH INSERTIONAL OR MIDPORTION ACHILLES TENDINOPATHY**

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Achilles tendinopathy can occur at the calcaneal insertion or within the midportion of the tendon. Symptoms are often similar and tendinosis is a feature in both presentations. However, insertional Achilles tendinopathy is notoriously recalcitrant to treatment. The purpose of this study was to examine if there are differences between individuals with insertional or midportion tendinopathy that might relate to differences in patient outcomes.

**Methods:** Individuals with insertional (I) and midportion (M) tendinopathy with verified tendinosis were included. The evaluation included elastography (cSWE), ultrasound imaging, questionnaires (VISA-A for symptoms, FAOS quality of life (FAOS-QOL), and Tampa Scale of kinesiophobia-TSK), and a heel-rise test.

**Results:** 28 (10 females, 21% with bilateral symptoms) mean (SD) age of 53 (15) individuals with midportion and 21 (14 females, 14% with bilateral symptoms) age 52 (14) with insertional tendinopathy were included. The insertional group had larger proportion of women and higher BMI with no other differences in demographics. Both groups had substantial degree of symptoms (VISA-A M=58.5, I=43), with significant differences (p=0.006-0.024) between the groups in FAOS-QOL (M=50, I=37.5) and TSK (M=38, I=40). The injured tendon had higher shear modulus (Limb symmetry Index (LSI) M=109%, I=108%), lower viscosity (LSI M=89%, I=93%), and was thicker (LSI M=147%, I=125%) with no significant difference between the groups. Both groups had significant deficit in heel-rise work (LSI M=87%, I=66%), but the insertional group had significantly (p<0.05) greater deficit and more pain with heel-rise.

**Conclusion:** The insertional group had more symptoms and functional deficits, but the tendon structure seemed similarly affected.

### **E23: THE EFFECT OF HIGH LOADING FOR REHABILITATION TREATMENT IN CHRONIC ACHILLES TENDINOPATHY**

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Eccentric training is a common approach in chronic Achilles tendinopathy. Current evidence suggests, that the intensity and the duration of loading are more important than the muscle contraction mode. Recently, Arampatzis et al. (2007) and Bohm et al. (2014) evidenced that the training intensity is considered to be optimal around 90% iMVC and the contraction duration around 3 s for the Achilles tendon adaptation in healthy participants. Thus, we hypothesize that a high load stimulus would provide a superior therapeutic effect for pathological tendons as well. We commenced a randomized controlled trial with a 12-week home-based intervention period. The ongoing study compares Alfredsons' classical eccentric protocol (n=12) with high load training proposed by Arampatzis et al. (2007) (i.e. 90% iMVC, 5 sets x 5 repetitions, 3 s loading 3 s relaxation) (n=13) with physiotherapy alone (controls, n=12), investigating its effects on tendon properties, functionality (jump performance, VISA-A score, iMVC) and pain.

At baseline, group characteristics did not differ and treatment compliance was similar in all groups (87.7±13.8%). VISA-A and normalized MVC improved significantly in all groups after the intervention (21.4 points and 4%, respectively) with no differences between groups. For all groups, drop jump height decreased (8.3%) along a reduced contact time (15.5%).

The trial is still ongoing. At this point, the results do not show additional benefits from eccentric or high load training compared to the classical physiotherapy treatment. Future analysis of the mechanical and morphological tendon properties may provide more information on structural changes of the tendon.

### **E24: PEOPLE WITH ACHILLES TENDINOPATHY DISPLAY GREATER FORCE FLUCTUATIONS THAN CONTROLS AT LOW FORCE LEVELS**

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Background: People with Achilles tendinopathy (AT) display reduced maximal planterflexor torque, but whether muscle force control tasks are affected is unknown. We aimed to compare muscle force control in AT and control groups, and whether torque and muscle force control change following a loading task.

Methods: 11 men with AT and 11 matched controls were recruited. A custom-made dynamometer was used to assess maximal voluntary contraction (MVC) and a 15-second force matching task (a measure of muscle force control) at 10% and 50% of MVC (randomised order) before and after an isometric task (5x45 sec at 70% MVC). Force fluctuations during force matching were quantified using coefficient of variation (CV). Change in MVC and force matching were investigated between groups (dominant leg of controls vs affected/most affected leg AT group) and pre-post the isometric task (ANCOVA [age as a covariate]).

Results: The AT group displayed significantly lower MVC ( $F(1) = 6.82$ ,  $p=0.017$ ) and greater CV at 10% MVC ( $F(1) = 7.32$ ,  $p=0.014$ ) compared with controls. CV did not change post the isometric task but there was a between group interaction for MVC ( $F(1,1) = 5.17$   $p=0.035$ ), with significant increase occurring in the AT group only. Among the AT group, there was a trend toward a correlation between symptom severity and force fluctuations at 10% ( $r=-0.57$ ,  $p=0.07$ ).

Conclusion: People with AT display decrement in muscle force control that may relate to symptom severity. Future studies should investigate whether muscle force control improves with current AT treatments or requires specific approaches.

### **E25: EXTRACORPOREAL SHOCK WAVE THERAPY OF HEALTHY ACHILLES TENDONS RESULTS IN A CONDITIONED PAIN MODULATION EFFECT**

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Introduction: Extracorporeal shockwave therapy (ESWT) is used to manage tendon pain. The effectiveness is uncertain and may be improved by understanding the mechanisms. We aimed to investigate whether ESWT of healthy Achilles tendons results in conditioned pain modulation (diffuse pain inhibition following a painful stimulus).

Methods: ESWT was performed on the dominant side Achilles tendon (3000 and 6000 shocks in a random order over 5-9 days) among 21 healthy participants (76% men, mean age = 27 years). ESWT pressure was adjusted so participants reported  $\geq 4$  out of 10 pain (10=worst pain imaginable) during application. Bilateral pressure pain thresholds (PPTs) were assessed at the Achilles tendon, tibialis anterior and lateral elbow in a random order

pre/post ESWT (repeated ANOVA). Factors associated with change in PPT were evaluated.

Results: PPT reliability was good to excellent at all sites (Intraclass correlation coefficient (3,1) = 0.75 to 0.88). There was large variation between participants, but PPTs increased significantly ( $p < 0.05$ ) and bilaterally at the Achilles (11.3% to 13.1%) and tibialis anterior (9.7% to 15.3%). At the elbow increases in PPT were smaller (5.9% to 11.8%), and only significant on the right for 6000 and left for 3000 shocks. Dose (3000 vs 6000), order (3000 shocks first vs second) and baseline PPT were not significantly associated with PPT change ( $p > 0.05$ ).

Conclusion: Achilles ESWT results in conditioned pain modulation that appears stronger in the lower limbs. Understanding the between person variability in response and whether this mechanism occurs in tendinopathy will inform appropriate use of this modality.

## **Free communication session F26-F30**

### **F26: LOWER ANKLE DORSIFLEXION IS ASSOCIATED WITH TENDON PATHOLOGY, DISABILITY AND PAIN IN ELITE JUMPING ATHLETES**

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The purpose of this study was to investigate the relationship between tendon pain, tendon ultrasound abnormalities, disability, weight-bearing ankle dorsiflexion (WBAD) and trunk and lower limb kinematics during a landing task in elite athletes with and without patellar tendinopathy. Twenty-four elite basketball and volleyball athletes, with or without patellar tendon pain, were included in this study. The athletes were evaluated regarding the worst pain in the previous week by means of a 10-cm visual analogue scale (VAS). Symptoms severity and disability were assessed with the Victorian Institute of Sport Assessment-Patella questionnaire (VISA-P). Pain during the single-leg decline squat test (SLS) was also measured with a VAS. Tendon thickness was measured with ultrasound examinations performed by an experienced sonographer. For the WBAD evaluation, the lunge test was used. Sagittal plane excursions of the trunk, hip, knee and ankle were also measured during a drop-landing task. For statistical analysis, the Pearson correlation test was used to verify the relationship between the variables. Results showed a negative correlation between WBAD and tendon pain ( $r = -0.413$ ;  $P = 0.045$ ) and tendon thickness ( $r = -0.488$ ;  $P = 0.016$ ). In addition, ankle excursion during landing significantly correlated with the VISA-P score ( $r = 0.491$ ;  $P = 0.015$ ) and with pain during the SLS ( $r = -0.485$ ;  $P = 0.016$ ). These results indicate that reduced ankle dorsiflexion range of motion, measured statically (lunge test) or dynamically (during a landing task), is associated with greater patellar tendon pathology and pain. A smaller ankle dorsiflexion excursion during landing is also associated with higher symptoms severity and disability in elite jumping athletes.

### **F27: QUALITY-OF-LIFE IN ACHILLES TENDINOPATHY**

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**Objective.** This research aimed to explore the quality-of-life and experiences of people with Achilles tendinopathy.

**Design.** This mixed-methods research used the eight-dimension Assessment of Quality-of-life (AQoL-8D), focus groups, and grounded theory analysis. AQoL-8D scores were compared with population normative scores. In focus groups, participants discussed their experiences with Achilles tendinopathy. **Setting.** An online survey was completed, followed by focus groups and interviews held at the University of Canberra. **Participants.** Adults with Achilles tendon pain were eligible to participate in the online survey, which was distributed via email and social media. **Results.** Complete survey responses were obtained from 92 individuals, and 11 individuals participated in focus groups and interviews. AQoL-8D scores were significantly lower in those with Achilles tendinopathy ( $79 \pm 11$  versus  $81 \pm 13$ ). AQoL-8D dimensions of: mental health; pain; senses; and the physical 'superdimension' were also significantly lower. The difference exceeded the AQoL-8D minimum clinically important difference of 6% only for the pain dimension. Themes identified included adapting lifestyles, living with the condition, changes in mental and social well-being, conflict with identity, frustration, and individual experiences. **Conclusion.** Achilles tendinopathy is associated with a lower quality-of-life score, but on average the difference does not exceed the minimum clinically important difference. In focus groups, some individuals described profound impacts upon their life. This discrepancy likely reflects the variability of the impact across individuals. For some people the effect is



minimal, yet for those who tie their identity and social activities to fitness and physical activity the effect can be profound.

## **F28: THE PREVALENCE OF SELF-REPORTED PSYCHOLOGICAL CHARACTERISTICS OF ADULTS WITH LOWER LIMB TENDINOPATHY**

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**Background:** Evidence exists that links depression, anxiety, kinesiophobia and catastrophizing with upper and lower limb tendinopathy. Recent work suggests those with more severe gluteal tendinopathy demonstrate lower pain self-efficacy, catastrophizing and depression. The aim of this study is to explore psychosocial characteristics among people with long-standing lower limb tendinopathy.

**Methods:** A single-centre cross-sectional cohort of 91 participants (44% aged 50 or over, 55% men) with a clinical diagnosis of lower limb tendinopathy for ≥3 months were included. Demographic, psychosocial (Hospital Anxiety and Depression Scale, Tampa Scale, Life Orientation Test – Revised) and general health data were collected. Self-rated functional ability was evaluated for each tendinopathy site. Descriptive, inferential and correlation statistics were generated.

**Results:** The predominant tendon complaint was Achilles (47%) followed by proximal hamstring (19%). 13% were classified as depressed, 21% as anxious and 63% scored high for kinesiophobia. Males were more optimistic. Kinesiophobia was not related to gender, tendinopathy site or duration of complaint but was related to the presence of anxiety ( $p=0.031$ ). Depression, anxiety and kinesiophobia were weakly negatively associated with general health. No relationship was observed for these variables with age, duration of symptoms, and tendinopathy site.

**Conclusion:** The prevalence kinesiophobia was relatively high in the current population. The prevalence of anxiety was higher than the Australian population and associated with kinesiophobia. The present study suggests that psychosocial factors and their relationship to tendinopathy is variable and reinforces the need to both screen for these factors and implement an individual patient-centred management plan.

## **F29: CHARACTERISATION OF ACHILLES TENDON PAIN USING MULTIPLE MULTIDIMENSIONAL PAIN SCALES**

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### **Background**

Achilles tendon pain is difficult to manage. Perhaps because the character of tendon pain is not yet fully described. To better understand it, perhaps we should treat it like any other chronic musculoskeletal pain and consider other clinical pain questionnaires in addition to the VISA-A to assess it. This study sought to assess tendon pain using two multidimensional questionnaires; short form McGill Pain Questionnaire (SF-MPQ) and short form Brief Pain inventory (SF-BPI) plus the VISA-A.

### **Methods**

In this clinical study conducted from November 2017 to date, 76 recreational runners suffering from chronic mid-portion tendinopathy completed the VISA-A, SF-BPI, SF-MPQ questionnaires as part of a larger study on pain in tendinopathy.

### **Results**

Sixty percent described their pain as aching. Significant proportions described it as tender (56%), shooting (26%), sharp (34%), stabbing (26%), hot burning (26%) and 54% ranked it as discomfiting or worse on the pain intensity score of the SF-MPQ. Tendon pain interfered with mood in 60% of the participants, sleep (43%) and enjoyment of life (60%). There was a weak correlation between the VISA-A and BPI scores,  $r^2=0.12$ ,  $p=0.002$  (95% CI: -0.52;-0.11).

### **Conclusion and recommendations**

Using several multi-dimensional scales to assess tendon pain can inform broader understandings of the behavior and nature of tendon pain. The preliminary data suggest that each scale assesses a different aspect of pain and therefore taken collectively, can enable an increased understanding of the nature of the pain and inform improved treatment programs.

### **F30: A PILOT CROSS-SECTIONAL STUDY OF PAIN IN INDIVIDUALS WITH PERSISTENT PLANTAR FASCIOPATHY**

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#### **Introduction**

Persistent tendinopathies were considered peripheral conditions affecting the local tendinous tissue however, quantitative sensory testing (QST) revealed altered central nociceptive processing is likely involved. Persistent plantar fasciopathy (PF) might likewise be more than just local tissue involvement. The aim of this study was to investigate whether QST assessments differed between individuals with PF and pain-free controls.

#### **Methods**

We recruited 16 individuals with PF (75% female, mean age: 47.0 ±9.4 years, mean BMI: 29.3 ±6.0 kg/m<sup>2</sup>) and 11 pain-free controls (56% female, mean age: 45.7 ±12.8 years, mean BMI: 22.7 ±2.5 kg/m<sup>2</sup>) for this study. PF diagnosis was: duration ≥3months, pain intensity ≥2/10, ultrasound measured fascial thickness ≥4mm. QST was performed locally under the heel and remotely on the ipsilateral elbow: assessments included pain thresholds for pressure (PPT), heat (HPT) and cold (CPT), and conditioned pain modulation (CPM = change in resting PPT with cold water immersion of hand). Participants rated their pain at QST thresholds. Additionally, the area of PF pain was drawn on a digital body chart. Exploratory analyses were performed and between-group differences/effects expressed as standardised mean differences (*d*).

#### **Results**

Largest effects were at local PPT and reported pain at PPT (*d*>1.8) followed by pain intensity for heat and cold QST thresholds. There was no CPM difference (*d*=0.1). PF pain area extended beyond the plantar heel.

#### **Conclusion**

No difference in CPM in conjunction with pain area extending beyond the plantar heel provides a basis for exploring local pressure hyperalgesia in a larger-scale study.

### **Management of Ageing Tendon & Tendinopathy**

#### **Keynote 5 - Management of Ageing Tendon & Tendinopathy**

#### **Regulation of tendon biology and mechanical properties in ageing and collagen tissue turnover in tendinopathy**

**Prof.dr. Michael Kjaer, Institute of Sports Medicine, Bispebjerg Hospital, University of Copenhagen, Denmark**

Aging is associated with a decreased potential for cell proliferation and a reduction in the number of stem/progenitor-like cells. In addition, there is evidence that turnover in the core of the tendon after maturity is very slow. Tendon fibril diameter, collagen content, and whole tendon size appear to be largely unchanged with aging, while glycation-derived cross-links increase substantially. Mechanically, aging appears to be associated with a reduction in modulus and strength. With respect to exercise, tendon cells respond by producing growth factors, and there is some support for a loading-induced increase in tendon collagen synthesis in humans, which likely reflects synthesis at the very periphery of the tendon rather than the core. Average collagen fibril diameter is largely unaffected by exercise, while there can be some hypertrophy of the whole tendon. In addition, it seems that resistance training can yield increased stiffness and modulus of the tendon and may reduce the amount of glycation. Exercise thereby tends to counteract the effects of aging.

In healthy Achilles tendons, no significant renewal of the weight-bearing collagen matrix seems to occur during adult life, but tendinopathy may lead to increased turnover. The carbon-14 (<sup>14</sup>C) bomb pulse method was used to measure lifelong replacement rates of collagen in tendinopathic and healthy Achilles tendons. Whereas, the healthy tendon collagen had not been replaced during adulthood, tendinopathic tendon demonstrated a substantial renewal. Modeling of the [<sup>14</sup>C] data suggested that one half of the collagen in tendinopathic matrix had undergone continuous slow turnover for years before the presentation of symptoms. This finding allows for a new concept in tendon pathogenesis because it suggests that either the symptoms of tendinopathy represent a late phase of a very prolonged disease process, or an abnormally high collagen exchange could be a risk factor for tendon disorders rather than being a result of disease.

## **Free communications session G31-G35**

### **G31: MEASURING PATIENT-REPORTED OUTCOMES (PROS/PROMS) IN PEOPLE WITH ACHILLES TENDINOPATHY: HOW USEFUL IS THE VISA-A?**

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**Introduction:** Patient-reported outcome measures (PROMs) are short questionnaires, which are self-reported and designed to capture a person's perceptions of specified aspects of their health status. Such questionnaires are ideally suited to areas such as tendinopathy where disease impact does not correlate consistently with biomarkers. The Victorian Institute of Sport- Achilles (VISA-A) questionnaire is a widely-used PROM for Achilles tendinopathy and is available in seven different languages. The ability of the VISA-A to improve decision making is determined by its reliability, validity and responsiveness to change, as these are essential psychometric properties for any measure. Here we critically review the evidence that exists for the VISA-A questionnaire.

**Methods:** A narrative critical review was undertaken.

**Results:** The processes for determining reliability, validity and responsiveness to change for the VISA-A are methodologically questionable by modern standards. Since the VISA-A was first published, both our understanding of the multidimensional nature of tendinopathy and PROMs has developed, and as such the VISA-A requires updating. To ensure methodological rigor, this should follow the CONsensus-based Standards for selection of health Measurement Instruments (COSMIN) recommendations for terminology and research agenda.

**Conclusion:** The VISA-A was published in 2001, and has now been widely used, offering easy comparison between treatments from various clinics and research studies. In absence of an alternative PROM, clinicians and researchers might continue to use the VISA-A as a primary outcome measure but should report their findings with recognition of the questionnaire's uncertain reliability, validity and responsiveness to change which may impact on findings.

### **G32: CAN THERAPEUTIC ULTRASOUND IMPROVE PAIN IN PATIENTS WITH LOWER LIMBS TENDINOPATHIES?**

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**Introduction:** Tendinopathy is a painful condition that occurs in the tendon, most often due to overload. Although, there have been advances in relation to the scientific evidence in the treatment of tendinopathy, there is still lack of studies to support the use of resources as therapeutic ultrasound. The aim of this study was to analyse the effect of therapeutic ultrasound associated with eccentric exercise in pain intensity in patients with lower limbs tendinopathies. **Method:** This controlled randomized and blind study was performed with 18 volunteers diagnosed with Patellar or Achilles tendinopathy were randomized in two groups. Group 1: Eccentric exercises; Group 2: Eccentric exercises associated to therapeutic ultrasound with 1 Mhz, 7 W, 100 Hz, Duty cycle 50% and SATA 0.5 W/cm<sup>2</sup>, energy of 2100 J per 10 minutes during three times a week per eight weeks. Pain assessment was performed with numerical rating scale (NRS) and VISA-A/P in two moments: pre-treatment, post treatment (8<sup>th</sup> week). **Results:** It was observed that there was no difference between groups in pain assessments by NRS: rest (p=0.77), during activity (p= 0.92 95% CI= -2.53-2.76), palpation (p=0.50 95% CI= -3.20-1.65), during single leg hop test (p=0.50 95% CI= -3.20-1.6). For the VISA questionnaire (p=0.06 95% CI = -1.08-33.307), there was a statistical trend favorable to the group 2 besides a significant clinical minimum difference of 16 points. **Conclusion:** The results of the present study suggest that the addition of therapeutic US to an eccentric exercise protocol does not suggest improvement of pain intensity.

### **G33: PLATELET-RICH PLASMA (PRP) AND TENDON HEALING: COMPARISON BETWEEN FRESH AND FROZEN-THAWED PRP**

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**Introduction:** Platelet-rich plasma (PRP) is increasingly used in the treatment of musculoskeletal diseases. Its preservation by freezing it for the realization of multiple injections in clinical use has never been discussed.

**Methods:** calcaneal tendons of rats were surgically sectioned. Platelet concentration of the PRP was 2,5 x 10<sup>6</sup>/ml with autologous plasma of rats. Frozen-thawed PRP was prepared by performing two cycles of freezing and

thawing on PRP aliquots. Both platelet preparations were injected in the lesion. Biomechanical and histological evaluations were carried out after 7, 20 or 40 days post surgery.

Results: After 7 and 40 days, no significant difference was observed between the PRP and the frozen-thawed PRP group. There is however a difference 20 days after surgery: the ultimate tensile strength (UTS) was greater in the fresh PRP group. No obvious difference with histological aspect was observed between the two groups.

Conclusions: Fresh PRP and frozen-thawed PRP injections can lead to similar results in the healing process of section calcaneal tendons of rats. Improvements with fresh PRP are slight. PRP could thus be frozen to be preserved if multiple injections are needed (e.g. osteoarthritis).

### **G34: EFFECTS OF ECCENTRIC EXERCISE ON TENDON STIFFNESS MEASURED BY SHEAR-WAVE ELASTOGRAPHY IN ACHILLES TENDINOPATHY**

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Introduction: Ultrasound is the gold standard imaging modality for Achilles tendinopathy (ATY) diagnosis. It is, however, an unreliable measure of treatment responsiveness as changes seen over time are minor. Shear-wave elastography (SWE) provides a quantitative measure of tendon stiffness. This study measured changes in SWE (m/s) during a 12-week eccentric exercise (EcEx) programme, a proven treatment for ATY.

Methods: 16 participants (32 tendons), with uni-lateral symptomatic US-confirmed ATY (12 males, 9 females; mean age 58±11 years) completed a 12-week EcEx programme, with measures of VISA-A, Visual Analogue Scale (VAS), Achilles tendon (AT) maximum anterior-posterior (MAP) diameter, doppler score, SWE, range of motion (ROM), muscular endurance and power at week 0, 4, 8, 12.

Results: The symptomatic AT's (SAT) experienced an increase in stiffness measured by SWE ( $p=0.001$ ). Increases were shown in VISA-A, ROM, muscular power ( $p<0.001$ ) and endurance ( $p=0.001$ ) with decreases in VAS and MAP diameter ( $p=0.01$ ). At baseline, scores between SAT and healthy tendons were different for VISA-A and VAS ( $p<0.001$ ), MAP diameter ( $p=0.01$ ), doppler score and SWE ( $p=0.004$ ). At 12 weeks VAS and SWE scores were no longer different between groups ( $p=0.07$  and  $p=0.25$  respectively).

Discussion: This is the first study to measure the effect of EcEx programmes on SAT and contra-lateral healthy tendons using SWE. It demonstrates an increase in SWE measures over time, correlating with improved pain and function reflected by outcome measures, in particular VISA-A. Although further work is required before SWE can be used clinically this data demonstrates its responsiveness to treatment in ATY.

### **G35: ISOMETRIC VERSUS ISOTONIC EXERCISE FOR GREATER TROCHANTERIC PAIN SYNDROME**

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Background: Greater trochanteric pain syndrome (GTPS) is a broad diagnostic term which includes gluteal tendinopathy. Limited evidence exists for the effectiveness of exercise for GTPS, and isometric and isotonic exercise programmes have not been directly compared. Our aim was to compare the effectiveness of isometric and isotonic exercise for individuals with GTPS.

Methods: This pilot randomised controlled trial recruited 27 participants (24F, 3M) with GTPS. The isometric group ( $n=14$ ) and isotonic group ( $n=13$ ) were similar for age, body mass index and duration of symptoms. Both programmes consisted of daily exercise for 12 weeks. Participants attended for 7 physiotherapy out-patient appointments over the trial period. The primary outcome measure was the VISA-G and secondary outcome measures were the numeric pain-rating scale (0-10) and an 11-point global rating of change scale (GRC). Outcome measures were assessed at baseline and 12 weeks.

Results: Twenty-one participants completed the trial with 3 drop-outs from each group; 1 due to increased knee pain, others were unrelated to the study. After 12 weeks, the mean VISA-G scores improved in both groups; 55 to 64 in the isometric (effect size 0.36) and 61 to 73 in the isotonic groups (effect size 0.74). Mean pain scores decreased by 2.3 (36%) in the isometric and 2.7 (46%) in the isotonic groups. Mean GRC scores increased by 1.9 in the isometric and 3 in the isotonic groups.

Conclusions: Isometric and isotonic exercise programmes appear to be effective for individuals with GTPS however a fully powered randomised controlled study is required.

## **Free communication session H36-H40**

### **H36: EFFECT OF ISOMETRIC EXERCISE ON CLINICAL OUTCOMES IN PATIENTS WITH LATERAL EPICONDYLALGIA: RANDOMIZED CLINICAL TRIAL**

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**Introduction:** There is evidence of benefit for multimodal treatments including exercise in the management of lateral epicondylalgia (LE), but little is known of the effects of isometric exercise alone. We investigated the effect of an 8-week home program of graded isometric exercise compared to wait-and-see on clinical outcomes in people with unilateral LE.

**Method:** 40 patients with LE were randomised to either wait-and-see (N=19) or an 8-week home exercise program (N=21). During a single session, patients assigned to exercise were instructed to complete a standardised daily program of isometric wrist extension with weekly increase in exercise volume. Primary outcomes were global rating of change (GROC) and Patient-rated Tennis Elbow Evaluation (PRTEE) at 8 weeks. Secondary outcomes were pain on an 11-point numerical rating scale, pain-free grip force, and thermal and pressure pain thresholds as a measure of nervous system sensitization.

**Results:** The exercise group had lower PRTEE scores (standardised mean difference, SMD: 0.86, 95% CI: 0.2-1.5) and lower ratings of worst pain (SMD: 0.80, 95% CI: 0.14-1.45) at 8 weeks compared to wait-and-see. No significant differences were observed between groups for all other measures.

**Conclusion:** Compared to wait-and-see, a home program of graded isometric exercise improved a validated measure of pain and disability for patients with LE. Success rates in both groups at 8 weeks were comparable to wait-and-see in previous clinical trials, suggesting isometric exercise alone may be insufficient in improving GROC outcomes. Isometric exercise may not have an effect on nervous system sensitisation in patients with LE.

### **H37: HIGH-VOLUME INJECTION WITH AND WITHOUT CORTICOSTEROID IN ACHILLES TENDINOPATHY: A RANDOMISED DOUBLE BLIND PROSPECTIVE STUDY**

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**Background:** High Volume Injections (HVI) have been shown to be superior to placebo injection for Achilles tendinopathy (AT). HVI consists of a large volume of saline with a small amount of corticosteroid and local anaesthetic, but corticosteroid may have deleterious long-term effects. We aimed to evaluate the efficacy of HVI with and without corticosteroid in AT.

**Methods** A total of 28 men (18 to 59 years) with chronic (>3 month) AT were randomised to receive a single injection of HVI with or without corticosteroid followed by identical advice and exercise. Participants and outcome assessors were blind to treatment allocation. Pain and function (Victorian Institute of Sport Assessment-Achilles [VISA-A, 0-100, 100=full function/no pain]), worst pain over the last week (visual analogue scale [VAS]) and tendon thickness on ultrasound were assessed at 6, 12 and 24-wks.

**Results:** VISA-A scores improved (increased) in both groups at all time points ( $p < 0.05$ ), with greater change in the HVI with corticosteroid (mean change $\pm$ SEM; 6-wks=31 $\pm$ 3; 12-wks=32 $\pm$ 5) versus HVI without corticosteroid (6-wks=14 $\pm$ 3; 12-wks=17 $\pm$ 3) at 6 and 12-wks ( $p < 0.05$ ) but not at 24-wks. Similarly, VAS pain scores and tendon thickness improved (decreased) significantly at all time-points but demonstrated significantly greater improvement in the HVI with corticosteroid versus without corticosteroid groups at 6 and 12-wks ( $p < 0.05$ ) but not 24-wks.

**Conclusion** HVI with or without corticosteroid combined with exercise is effective in managing AT in the medium-term, but HVI with corticosteroid was superior in the short-term indicating a corticosteroid effect. Long-term effects and adverse events of this treatment warrant investigation.

### **H38: DOES HIGHER DOSE EXERCISE IMPROVE OUTCOMES IN ROTATOR CUFF TENDINOPATHY? A SYSTEMATIC REVIEW WITH META-ANALYSIS**

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Background: The efficacy of exercise in rotator cuff tendinopathy is uncertain and the effect of exercise dose has not been evaluated in meta-analyses. We synthesised evidence comparing progressive/resisted exercise (or not) to placebo/no treatment or comparing higher and lower dose exercise.

Methods: Multiple databases (Cochrane CENTRAL, PEDro, MEDLINE, EMBASE, CINAHL) were searched for randomised controlled trials (RCTs) comparing: 1) progressive resisted or non-progressive/non-resisted exercise with a placebo/no treatment, or 2) higher versus lower dose (volume or load) exercise. Effect sizes were calculated and data were synthesized in meta-analyses where possible.

Results: Progressive and resisted exercise (but not non-progressive/non-resisted exercise) resulted in clinically meaningful benefit for function (Mean difference [MD] = 10.52 [95% CI=4.30 to 16.58]), pain with activity (MD = 2.09 [1.23 to 2.94]) and pain at rest (MD = 1.15 [0.43 to 1.83]) compared to placebo/no treatment in the short to medium term. Progressive and resisted exercise (yes or no) was the only significant predictor of function ( $b = 0.66$  [0.08 to 1.24],  $p < 0.0259$ ) in meta-regression analysis (clinically meaningful benefit of 14.52 [1.76 to 27.28]). Higher volume but not higher load exercise was generally associated with superior function and pain outcomes in the short to medium term. The overall quality of evidence based upon GRADE criteria was low.

Conclusions: Based upon low quality evidence, resisted and progressive exercise, especially if greater volume, appears to be associated with improved pain and function outcome in the short to medium term among people with rotator cuff tendinopathy.

### **H39: A RANDOMISED CROSSOVER TRIAL OF THE INITIAL EFFECTS OF ISOMETRIC EXERCISE ON PLANTAR FASCIOPATHY**

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#### **Introduction**

Isometric exercise is commonly recommended for reducing pain in individuals suffering from lower limb tendinopathies, despite the limited evidence supporting its analgesic effect. Due to the similarities between plantar fasciopathy and tendinopathies, the aim of this trial was to investigate the acute effect of isometric exercise on pain, compared to isotonic exercise, or walking, in individuals with plantar fasciopathy.

#### **Methods**

We recruited 20 individuals with plantar fasciopathy for this prospectively-registered, participant-blinded, randomised, superiority crossover trial (ClinicalTrials.gov: NCT03264729). Participants attended three exercise sessions (isometric, isotonic or walking) in a randomised order, within a two-week period. Both isometric and isotonic exercises were performed standing with the forefoot on a step bench, while walking was performed barefoot. The primary outcome was pain (measured on a 0-100mm VAS) during a pain-aggravating activity. Secondary outcomes included pressure pain threshold (PPT) under the heel, and plantar fascia thickness (PFT) measured by ultrasound. All outcomes were measured before and after each exercise session.

#### **Results**

There were no significant differences between the three exercises on pain ( $P=0.753$ ), PPTs ( $P=0.837$ ) or PFT ( $P=0.718$ ). Further, there was no change in pain from before to after any of the exercises (isometric exercise 2.7mm (95%CI: -12.2; 6.8), isotonic exercise -3.4mm (95%CI: -5.0; 11.8) or walking 1.6mm (95%CI: -16.1; 12.9)).

#### **Conclusion**

Contrary to expectations, isometric exercise was no better than isotonic exercise or walking at reducing pain in individuals with plantar fasciopathy. None of the exercises induced any analgesic effect.

#### **H40: THE 10,000 TENDONS STUDY: A MULTI-LEVEL INTERNATIONAL COHORT STUDY OF 5 TENDINOPATHIES.**

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Introduction: Tendinopathy is a minor problem in comparative health terms, unless it does not get better. Recalcitrant tendinopathy however, has significant costs for society, individual health, exercise and sporting participation and is one of the most commonly diagnosed musculoskeletal pathologies in Western society. We have insufficient causal knowledge about why some people with tendinopathy get better and others do not. We aim to develop a multi-level phenotype of five tendinopathies in order to inform two clinician-facing mathematical models of tendinopathy outcome.

Methods: We will recruit 10000 participants comprising 5 groups with equal numbers of participants diagnosed with 5 tendinopathies, pain in the same area with an alternative diagnosis and matched healthy controls in an international study. All will complete online questionnaires and functional tests. 3000 will have a clinical and ultrasound examination while a nested sub-set of 600 will have a biomechanical assessment. All participants will be followed for at least 18 months to determine outcomes. Feasibility studies are nearing completion so data collection tools will be finalised prior to ISTS 2018.

Results: The data will inform both an existing Bayesian probabilistic causal model designed as a decision support tool, and a novel regression model. This tool will be available to clinicians assessing patients with tendinopathy to assist their musculoskeletal clinical reasoning within the context of evolving Learning Health Systems. Patient facing tools will be developed.

Conclusion: We seek big data answers to resistant research questions, and extend an invitation to collaborators to share the journey.

## **Posters P1-P85 (including Poster for the Poster Pitch P1-P48)**

### **P1: PHOTOBIOMODULATION ON EARLY PHASE OF TENDON RUPTURE REHABILITATION: CASE SERIES**

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**Objective:** The aim of this study is to assess the effect of photobiomodulation on Achilles tendon rupture (ATR) in the first 8 weeks following the lesion.

**Background data:** ATR is one of the most common sport injury and it can takes weeks and even months to heal. The acute and proliferative phases are crucial to improve tendon repair and the PBMt application on the first weeks after the tendon rupture may be used as adjuvant therapy.

**Methods:** Six male patients with Achilles tendon rupture were treated non-surgically with seriated plaster removal immobilization lasting 8 weeks. Within eight weeks, patients were underwent to a PMBt protocol, consisting of 16 sessions, with following parameters: Cluster 904 nm, 858nm and 658nm, energy 15 J, associated to an exercise protocol. Assessments were performed regarding to function (ATRS score/heel-rise test), ankle ROM, calf muscle strength and pain at 8<sup>th</sup>, 12<sup>th</sup> and 16<sup>th</sup> weeks after tendon rupture. Normal parameters with normal distributions and homogeneous variances and Student's t test were used to evaluate significant differences in mean values. The critical level of significance was  $p < 0.05$ .

**Results:** Subjects presented an improved function through ATRS score ( $p < 0.05$ , 12<sup>th</sup> week  $57.6 \pm 12.3$ ; 16<sup>th</sup> week  $38.4 \pm 13$ ) and strength ( $p < 0.001$ , 12<sup>th</sup> week  $48.2 \pm 22.8$ ; 16<sup>th</sup> week  $68.9 \pm 27.9$ ) increase in the periods of 12 and 16 weeks after rupture but no differences were detected regarding ankle ROM, heel-rise test and pain.

**Conclusions:** It was possible to observe that PBMt increased the calf muscle strength and ankle function through ATRS score.

### **P2: PLANTARIS EXCISION AND ACHILLES SCRAPING IMPROVES PAIN AND STRUCTURE: A LONG TERM CASE SERIES**

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Introduction:

The plantaris tendon has recently been described as a possible contributing factor to persistent mid-portion Achilles tendinopathy. Studies with short-term follow-up report reduced Achilles pain and improved structure after plantaris tendon excision. The aim of this case series was to determine long-term outcomes with active adverse event determination.

Methods:

Consecutive participants from 10/2014 to 7/2015 with mid-portion Achilles tendinopathy, predominantly medial tendon pain and/or tenderness, evidence of visual plantaris tendon compression using 2D ultrasound and ultrasound tissue characterisation (UTC) and having undergone plantaris tendon excision and Achilles tendon scraping under local anaesthetic with a single surgeon were recruited. Treatment also included post-operative calf strengthening and progressive return to sporting activity. VISA-A score was used to assess clinical outcomes, and UTC to assess tendon structure.

Results:

13 male and 5 female participants were recruited, aged (mean $\pm$ sd)  $39.2 \pm 7.2$  years with symptoms for  $27.9 \pm 34.9$  months. Importantly, all were active in sport including three elite athletes. Sixteen participants were assessed 24 months post-procedure, with two lost to follow-up. VISA-A scores increased from  $58.2 \pm 15.9$  to  $92.0 \pm 9.2$  ( $d = 2.7$ , 95% CI =  $25.2 - 42.8$ ,  $p < 0.01$ ). Structure also improved with organised echo pixels (UTC type I+II) increasing from  $79.9 \pm 11.5$  to  $86.4 \pm 10.0$  ( $d = 0.6$ , 95% CI =  $-0.80 - 13.80$ ,  $p = 0.01$ ) greater than the 3.4% minimum detectable change. All responding participants reported satisfaction and 14 returned to pre-injury activity levels. There were no reported complications.

Conclusion

Improved function and Achilles tendon structure were observed post-plantaris tendon excision and Achilles scraping at 24 month follow up. The procedure was without complications, and a randomised clinical trial is warranted.



### **P3: PRESERVATION OF TENDON FASCICLE FAILURE STRESS IN Ovariectomized Rats Following Phytoestrogen Treatment: Role for Tenomodulin?**

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Tendinopathies are three-fold higher postmenopause, likely due to reduced estrogen. In a rat model of postmenopause [ovariectomized (OVX)], tendon collagen loss is attenuated by treatment with the phytoestrogen genistein. The influence of genistein on tendon mechanical properties and the mechanisms contributing to collagen preservation are not known. The purpose of this study was to determine the impact of genistein on tendon gene expression and fascicle function. Six-week-old rats (n=24) were divided into three groups: intact, OVX, or OVX-genistein (6mg/kg/day) for 6-weeks. Individual tail fascicles were assessed with a Deben microtest tensile stage. Total RNA was isolated from Achilles tendons and mRNA expression determined with digital droplet PCR. Compared to intact rats, tensile stress was lower in untreated OVX rats ( $p<0.05$ ) but not in genistein-treated rats ( $p>0.05$ ). Neither OVX nor genistein altered expression of Col1a1, Col3a1, Casp3, Casp8, Mmp1a, Mmp2, and Mmp9 ( $p>0.05$ ). Compared to intact rats, Tnmd, Scx, and Esr1 expression was increased and Pcna and Timp1 expression was decreased in OVX rats. Genistein treatment normalized Tnmd, Pcna, and Timp1 expression ( $p<0.05$ ), but did not alter Scx or Esr1 expression ( $p>0.05$ ). Dcn expression was higher in genistein rats when compared to OVX ( $p<0.05$ ), but was not affected by OVX ( $p>0.05$ ). Our findings suggest that genistein can improve tendon mechanical properties in a postmenopausal model. The improvement may be related to genistein effects on Tnmd and Pcna rather than direct effects on collagen remodeling.

### **P4: ECCENTRIC TRAINING FOR TENDON HEALING AFTER ACUTE LESION: A RAT MODEL**

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#### **INTRODUCTION:**

Platelet-rich plasma (PRP) injection has been shown to have a beneficial effect on tendon healing after lesion in rats. Furthermore, eccentric exercise seems to improve the mechanical quality of the tendon. A combination of PRP injection and eccentric training might be more effective than either treatment alone.

#### **METHODS:**

Rats were anesthetized, an incision was performed in the middle of their left patellar tendon and an injection of physiological fluid (PF) or homologous PRP was randomly made. The rats were then divided into 2 groups: the eccentric group, and the untrained group. After 5 weeks, the tendons were removed and their ultimate tensile strength and energy were measured. Tendons were frozen for proteomic analyses when all biomechanical tests were completed. Statistical analysis was performed with linear mixed effect models.

#### **RESULTS:**

No significant difference was found between the treatments using PF injection or PRP injection alone. However, the value of the ultimate tensile force at rupture was increased by 4.5 N (108% of control,  $P = .006$ ) when eccentric training was performed. Proteomic analysis revealed that eccentric training led to an increase in abundance of several cytoskeletal proteins in the PF group, while a decrease in abundance of enzymes of the glycolytic pathway occurred in the PRP-treated groups, indicating that this treatment might redirect the exercise-driven metabolic plasticity of the tendon.

#### **CONCLUSION:**

Eccentric training altered the metabolic plasticity of tendon and led to an improvement of injured tendon resistance regardless of the treatment injected (PF or PRP).

### **P5: SPANISH CONSENSUS STATEMENT CLINICAL MANAGEMENT OF TENDINOPATHIES IN SPORT**

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#### **Introduction**

On the 15th of October, 2016; experts met at Clínica CEMTRO in Madrid, Spain, under the patronage of various prominent Spanish Sports associations with the aim of establishing a round table which would allow specialists to consider the most appropriate current general actions to be taken about clinical management and treatment of tendinopathies in sports, based on proven scientific data described in medical literature as well as on each author's experience.

## Method

Each expert received a questionnaire prior to the fore mentioned meeting comprising a set of questions concerning clinical management and treatment of tendinopathies in sports. Levels of consensus were described as unanimous (100%), highly recommended (75%-99%), recommended (55%-74%), and controversial(<55%).

## Results

For the Clinical Management Block, there was Unanimity concerning when to suspect a partial tendon tear and for the ideal diagnosis: consider clinical, echography, and magnetic resonance imaging findings. Highly recommended answers were shown for Peritendinitis concept, Can clinically differentiate an intratendinous disorder from an extratendinous one and evaluation based on clinical findings and image tests.

For the Treatment Block, highly recommended answers were shown for indicated surgery and use of orthobiologic products.

## Conclusions

Participants had a higher degree of consensus when defining pathological entities from the clinical management block. A certain degree of controversy was found in the treatment block since there is no golden, one-size-fits-all therapeutic approach. Certain treatments are more likely to be therapeutically indicated. Further studies and consensus sessions are necessary in translational medicine, with the aim of adapting treatments to each tendon pathology.

## **P6: DOES SPORTS TAPE CORRECT GAIT ABNORMALITIES IN WOMEN WITH GTPS? A DOUBLE-BLIND RANDOMISED CROSSOVER TRIAL**

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**Introduction:** There is considerable debate among clinicians as to whether sports tape can provide mechanical support. People with greater trochanteric pain syndrome (GTPS) have increased adduction moment, adduction angle and pelvic obliquity, likely contributing to the continuation of the pathology. We aimed to see if sports tape could control these movements.

**Methods:** Fifty women with GTPS participated in a three-dimensional gait analysis. Each participant performed three walking trials: baseline, and two subsequent trials with active and sham applications of Dynamic Tape randomised for order. Differences in kinetic and kinematic data were analysed using mixed model linear regressions for each condition.

**Results:** Hip adduction moment was reduced at first peak by both active ( $p<0.001$ ) and the sham tape ( $p=0.028$ ) (with no difference between active and sham taping); and at second peak by the active taping alone ( $p<0.001$ ). Adduction angle was reduced at first peak by both active ( $p<0.001$ ) and sham taping ( $p=0.026$ ), with the active taping producing a larger reduction than the sham taping ( $p=0.004$ ); at mid-stance the active taping alone reduced the adduction angle ( $p=0.003$ ); there was no reduction in adduction angle at second peak. Internal rotation was reduced at the first and second peaks, and mid-stance by the active taping alone ( $p<0.001$ ). Pelvic obliquity was reduced at the first and second peaks by the active tape ( $p<0.02$ ) (with no difference between active and sham taping), and by the active tape alone at mid-stance ( $p<0.001$ ).

**Conclusion:** Dynamic Tape produces a mechanical effect on women with GTPS.

## **P7: HOW DO PHYSIOTHERAPISTS ASSESS AND MANAGE GREATER TROCHANTERIC PAIN SYNDROME?**

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**Background:** Greater trochanteric pain syndrome (GTPS) causes recurrent, disabling pain over and around the greater trochanter. With an incidence of 1.8/1000, and more common in older women than men, it affects work participation and quality of life. Although physiotherapy is a common treatment option for GTPS, there is no consensus on optimal treatment. The aim of this study was to establish current physiotherapy assessment and management of GTPS and identify preferred methods for updating knowledge on GTPS management.

**Methods:** A cross-sectional anonymised online survey of registered physiotherapists in Ireland, Australia and New Zealand was conducted, following ethics approval.

**Results:** A total of 361 physiotherapists provided valid responses. Physiotherapists in Ireland, Australia and New Zealand approach GTPS diagnosis and treatment similarly. With respect to diagnosis, lateral hip pain with loading or sidelying were the most useful symptoms (86%); 86% use greater trochanter palpation and 73% use the single

leg stance test. Only 25-37% used imaging to assist with diagnosis. Education (100%) and exercise (99%) were most the common interventions, followed by manual therapy/massage (90%). Electrotherapies were used by 25%. Up to 70% of therapists always included Gluteus Medius/Minimus strengthening; 75% included functional neuromuscular control exercise. The most common education topics were self- and load-management. Hands-on clinical experience and GTPS-specific courses were predominantly used to update knowledge.

**Conclusions:** Clinical examination was more important than imaging in diagnosis of GTPS. Education and exercise were the most common interventions used by physiotherapists. Results may inform future interventional studies to determine effectiveness of physiotherapy interventions.

#### **P8: DOES SURGERY WORK FOR TENDINOPATHY? A SYSTEMATIC REVIEW OF RANDOMISED STUDIES**

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**Background/Purpose:** The effectiveness of surgery and its superiority to other treatments in tendinopathy remain controversial. Our aim was to assess the effects of surgery compared with other treatments in all tendinopathies.

**Methods:** A thorough literature search was conducted aiming to identify randomised studies comparing the effects of surgery with non-surgical treatments, placebo or sham surgery on tendinopathy. Overall quality of each eligible study was determined based on a combined assessment of internal validity, external validity and precision. Strength of evidence was rated as strong, moderate, poor or no evidence based on the classification system by Van Tulder et al. (1997).

**Results:** A total of 12 eligible studies were identified (seven rotator cuff disease, three lateral epicondylitis, one Achilles tendinopathy, one patellar tendinopathy). Based on evidence of at least moderate strength, surgery for chronic tendinopathy did not appear to be superior to physiotherapy in terms of pain, function, ROM and strength in the short/mid-term and treatment success, pain and quality of life in the long-term. Additionally, surgery was no more effective than sham surgery in terms of pain, function, ROM and complications in the short/mid-term. Compared with no treatment or placebo (detuned laser), surgery provided benefits in terms of pain, function, ROM and treatment success and was not associated with more complications in the short/mid-term. Finally, surgery and ESWT were found to be equally effective in relieving pain.

**Discussion/Conclusions:** The surgical management of chronic tendinopathy does not appear to be more effective than physiotherapy (short/mid-term and long-term) or sham surgery (short/mid-term).

#### **P9: VIBRATION TRAINING REDUCES PAIN AND FUNCTIONAL LIMITATIONS IN PATIENTS WITH PATELLAR TENDINOPATHY**

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Patellar tendinopathy (PT) causes pain and functional limitations. Strength training regimes are successful therapeutic interventions, but often demanding and painful. Whole body vibration (WBV) training has been shown to exert an anabolic effect for bone, muscle and recently, tendon tissues. However, this intervention, which involves lower load intensity than typical resistance training, has never been tested as an alternative conservative treatment. The purpose of this controlled trial was to test the effectiveness of WBV to treat PT.

Within this study, in the period 2017-2019, patients with chronic recalcitrant PT were recruited and randomized to either WBV training, heavy slow resistance training (HSR) or control (CON) groups. Before and after a three-month intervention, VAS and VISA-P scores, ultrasonographic features of tendon pathology (hypoechoic areas and/or tendon thickening) and isokinetic knee extensor strength were assessed. Differences in main outcome variables were tested with a repeated-measure ANOVA.

Ten patients of the CON, nine of the WBV and six of the HSR groups have so far completed the study. There were significant group x time interactions for the VAS ( $p = 0,013$ ;  $F = 5,311$ ) and VISA-P ( $p = 0,018$ ;  $F = 4,889$ ) scores with improvements in the WBV and HSR groups only. There was no interaction effect for isokinetic strength. Tendon degeneration was reduced in eight out of nine WBV patients and in five out of six HSR patients, with no change for the CON group.

These preliminary results indicate that WBV may be as effective as HSR in reducing pain and functional limitations.

#### **P10: A SYSTEMATIC REVIEW OF CLINICAL TRIALS OF EXERCISE FOR TIBIALIS POSTERIOR TENDINOPATHY**

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**Introduction:** Altered foot posture, impaired local strength and functional deficits are characteristics of tibialis posterior tendinopathy (TPT). Exercise is currently regarded as the mainstay of conservative management for tendinopathy. This systematic review aimed to comprehensively review all randomised clinical trials (RCTs) and provide estimates of treatment effects of local strengthening exercises and evaluate the completeness of exercise prescription parameters for included trials.

**Methods:** CINAHL, Cochrane, Embase and PubMed databases (inception – 2017) were searched. Main selection criteria were RCTs of local strengthening compared to other conservative treatments on pain, function and/or physical impairment in adult TPT. Standardised mean differences (SMDs) were used to compare change scores between groups and descriptors of exercise prescription assessed according to the Toigo and Boutellier recommendations.

**Results:** Different strengthening exercises were compared to stretching and orthotic prescription (n=2) or no intervention (n=1). Eccentric strengthening exercises combined with orthoses and stretching result in significant reductions in self-reported pain, disability and overall foot function compared to other management strategies at 12 weeks (SMD >0.85). Evaluation of exercise prescription parameters revealed that no trial provided complete descriptions; only repetitions, sets, and experiment period were consistently described.

**Conclusion:** Clinicians should be guided by their clinical reasoning as there is a paucity of high-quality research for the conservative management of TPT and exercise prescription parameters are poorly reported. Based on the limited available literature, local strengthening (eccentric) exercises may have benefit in TPT, however optimal exercise prescription has not been described.

#### **P11: THE USE OF PLATELET-RICH PLASMA (PRP) TO TREAT CHRONIC TENDINOPATHIES: A TECHNICAL ANALYSIS**

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**Introduction:** Platelet-rich plasma (PRP) is blood plasma with a high concentration of autologous platelets which constitute an immense reservoir of growth factors. The clinical use of PRP is widespread in various medical applications. Although highly popular with athletes, the use of PRP for the treatment of tendinopathies remains scientifically controversial, particularly due to the diversity of products that go by the name of “PRP.” To optimize its use, it is important to look at the various stages of obtaining PRP.

**Methods:** In this literature review, we take a closer look at eight parameters which may influence the quality of PRP: 1) anticoagulants used to preserve the best platelet function, 2) the speed of centrifugation used to extract the platelets, 3) the platelet concentrations obtained, 4) the impact of the concentration of leukocytes and erythrocytes on PRP actions, 5) platelet activators encouraging platelet degranulation and, hence, the release of growth factors, and 6) the use or nonuse of local anesthetics when carrying out infiltration. In addition to these parameters, it may be interesting to analyze other variables such as 7) the use of ultrasound guidance during the injection with a view to determining the influence they have on potential recovery.

**Results:** There is a lack of standardization in PRP preparation technique for tendinopathies. However it appears that the use of a platelet concentration lower than 5 times the baseline, and avoidance of leukocytes should be preferred.

**Conclusion:** More standardized studies are needed to optimize the efficacy of PRP treatments for tendinopathies.

#### **P12: COMPARISON OF PLATELET-RICH PLASMA VERSUS HYALURONIC ACID INJECTIONS TO TREAT PATELLAR TENDINOPATHIES**

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**Introduction:** Patellar tendinopathies remain often chronic. For this reason, lots of research is carry out to develop treatments, among which platelet-rich plasma (PRP) and hyaluronic acid (HA). Thus we aimed to compare the effect of PRP versus HA injections after three months on patients who have a proximal patellar tendinopathy.

**Methods:** 33 sportsmen with chronic proximal patellar tendinopathies were included and randomized into 2 groups and benefited of PRP (obtained with an aphaeresis machine) or HA injections respectively. Concerning the evaluation of the pathology, algo-functional tests (VISA-P and IKDC), isokinetic along with the patellar tendon ultrasonography have been realized pre-injection, after 6 weeks, after 3 months post-injections.

**Results:** The results of VAS, algometric scores, IKDC scores and VISA-P showed a considerable improvement in the

two groups with time ( $p < 0.01$ ), except for the US findings. Isokinetic tests showed significant modifications for the quadriceps in C60 ( $p = 0.01$ ) for the pathological limb at the end of follow-up only. VAS associated with isokinetic tests decreased significantly for all contraction modes after three months in the HA group ( $p < 0.005$ ). Correlations showed that there was a significantly negative association between VAS and strength in C60, C240 and E30 ( $p < 0.01$ ) only for the PRP group.

Conclusion: Both PRP and HA can improve the symptoms of proximal patellar tendinopathy at medium terme. However, only PRP leads to a decrease of pain associated to increase of strenght of the quadriceps.

### **P13: MORPHOMECHANICAL OUTCOMES OF THE TRICEPS SURAE MUSCLE-TENDON AFTER AN ACHILLES TENDON REPAIR**

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#### **Introduction:**

Myotendinous morphomechanics describing morphologies of muscle fascicle and mechanical properties of tendinous tissue play crucial roles in the musculoskeletal function. Previous studies showed a significant correlation between muscle morphologies and heel raise ability. The aim of this study is to investigate the muscle morphologies change during dynamic movement after Achilles tendon rupture (ATR).

#### **Methods:**

This cross-sectional study included patients from four hospitals, who were treated for unilateral Achilles tendon repair within a year period. Altogether nine patients aged between 20 and 60 years old without systemic disease were recruited. The participants received bilateral measurements of medial gastrocnemius (MG) muscle fascicle morphologies by ultrasound imaging during concentric-eccentric plantarflexion performed with one-leg-stand on the edge of a wood box.

#### **Results:**

Compared to the healthy leg, the injured leg showed significantly shorter fascicle length ( $p = 0.008 \sim 0.028$ ), larger fascicle angle (FA) ( $p = 0.011 \sim 0.038$ ) and longer tendinous tissue length ( $p = 0.008 \sim 0.021$ ) during each five percent cycle concentric-eccentric transition.

#### **Conclusions/Discussion:**

This study provides evidence to suggest that shorter fascicle length reduced heel rise height which increases FA to achieve maximum dynamic plantarflexion in the injured leg. Findings also suggest lowered deep aponeurosis stiffness of MG in the injured leg increased compliance of tendinous tissue suggesting greater FA. However, a larger FA does not translate into greater muscle force production and leads to a worsened functional outcome. Our results imply that morphomechanical change influences musculoskeletal function. Based on this research, patients after ATR should continue high intensity and dynamic training to improve myotendinous morphomechanics and elevate exercise performance.

### **P14: FREQUENCY OF PATHOLOGY ON DIAGNOSTIC ULTRASOUND IN INDIVIDUALS WITH INSERTIONAL ACHILLES TENDINOPATHY**

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Insertional Achilles tendinopathy accounts for 20-25% of all Achilles tendinopathy and likely is caused by a variety of underlying conditions. The underlying pathology of insertional Achilles tendinopathy may partially account for the recalcitrant nature of this condition to treatment. Ultrasound imaging may assist in identifying underlying pathology to improve specificity of treatment.

**Objectives:** The purpose of this study was to quantify the presence of underlying Achilles tendon insertional pathology using ultrasound imaging. Secondly, we sought to examine the alignment of treatment strategy on underlying pathology.

**Methods:** Individuals with a primary clinical diagnosis of insertional Achilles tendinopathy were included in this study. B-mode ultrasound imaging was used to descriptively and quantitatively describe tendon pathology. Use of diagnostic imaging and treatment modalities in clinical management was measured via participant survey.

**Results:** Of the 56 individuals included in this study, 51.8% had a bony defect, 35.7% had intratendinous calcifications, 51.8% had distal tendinosis, 28.6% had midportion tendinosis, 33.9% had bursitis, and none had isolated paratenonitis on their more symptomatic side. Participants reported previously having the following

imaging for their Achilles tendon-related condition: 44.6% X-ray, 16.1% MRI, 14.3% ultrasound, and 1.8% CT scan. For treatment, 17.9% of participants reported having received shockwave treatment, 12.5% laser treatment, 10.7% injection, and 3.6% surgery.

**Conclusion:** Patients with insertional symptoms present with multiple underlying pathologies which may respond differently to treatment. It may be helpful to differentiate insertional Achilles tendinopathy based on underlying pathology to better understand response to interventional strategies and tailor treatment accordingly.

#### **P15: PROGNOSTIC FACTORS FOR OUTCOME FOLLOWING EXERCISE INTERVENTIONS FOR ACHILLES TENDINOPATHY: A SYSTEMATIC REVIEW AND META-ANALYSIS**

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**Introduction:** Rehabilitation is recommended first line treatment in Achilles tendinopathy (AT) and there is large variation in response both between individuals and studies. This systematic review aimed to synthesize current evidence on prognostic factors in AT exercise management.

**Methods:** Studies investigating prognostic factors during exercise intervention for AT were included. Predictive ability of included predictors was assessed using meta-analyses where possible, in other case levels of evidence were determined and the findings summarized descriptively.

**Results:** Nineteen studies were included (all high risk of bias). There is limited evidence that tendon structure, Doppler signal and insertional pathology are inconsistently (across related predictors and/or outcome constructs) associated with worse outcome but most imaging measures (e.g. presence of pathology, tendon thickness and tendon shape) had no or conflicting predictive value. Female gender, higher BMI and greater baseline symptoms were associated with poorer outcomes, but not consistently within and across outcome constructs. In contrast, age, prior activity level, diabetes mellitus, race, baseline pain on palpation and duration of symptoms were generally not associated with outcome.

**Conclusion:** Tendon pathology rarely and inconsistently provided prognostic value, which is generally consistent with tendon pathology being a weak risk factor for developing of Achilles tendinopathy. For people between 43-54 years the response to exercise interventions is not influenced by age. Similarly, BMI, duration of symptoms and male gender do not appear to be reliable prognostic factors. This may be explained by the limited evidence-base, but also suggests psychosocial and other uninvestigated factors may be more important predictors.

#### **P16: ALTERATION ON PATELLA TENDON SHEAR MODULUS IN FEMALES WITH KNEE OSTEOARTHRITIS**

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**Introduction:**

Knee osteoarthritis (KOA) is a common chronic disease in older population affecting all tissues within the joint, including patellar tendon (PT). Usage-related pain is frequently reported by KOA patients in PT region. It is postulated that PT, in the perspective of mechanical property, is also altered by the pathology of OA. Therefore, this study aimed to investigate difference of Young's modulus in the older with or without KOA.

**Methods:**

This study is an exploratory cross-sectional study. KOA patients were recruited from local hospital and healthy controls from community. Subjects were lying supine on a plinth with hip in neutral and knee in 60° flexion. Right knee was selected for assessment. Mechanical property was measured by an Aixplorer ultrasound shearwave elastography system with "MSK" preset. Ultrasound transducer was positioned parallel to longitudinal axis of PT. Young's modulus was measured 0.5cm distal to patella inferior pole with ROI of 3mm and averaged through five images.

**Results:**

22 females with KOA (age:62.3±5.3, BMI:27.0±3.9) and 19 without KOA (age:63.7±3.9, BMI:21.8±3.3) were recruited. Young's modulus of PT was 97.52±56.45 KPa in patients and 118.00±67.02 KPa in controls at 0.5cm. Significant difference ( $p=0.02$ ) was found between two groups after controlling age and BMI.

**Conclusions/Discussion:**

The result of this study suggests that females with KOA have lower Young's modulus than those without KOA, indicating decreased elasticity in these patients. PT is involved in the KOA. The altered elasticity might weaken the knee extensor mechanism and contribute to functional limitation or fatigue in KOA.

## **P17: MRI MEASUREMENT ON WATER CONTENT IN PATELLAR TENDON: ITS RELATIONSHIP WITH TENDON STIFFNESS AND PAIN**

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### **INTRODUCTION**

Patellar tendinopathy is a failed healing response to overloading of the tendon. It presents with pain, swelling and leads to functional disability. Changes in tendon stiffness have been reported in subjects with patellar tendinopathy. One of the possible reason for such change is an increase in water content. The relationship between percentage of water content and tendon stiffness is unexplored. Such information enables better understand on the relationship between tendon physiological and mechanical properties.

### **METHODS**

Eleven male athletes with age between 18 and 22 were recruited from the badminton and track and field teams. Six had clinical diagnosis of unilateral patellar tendinopathy for more than 6 months. Their mean training hour per week was 9.8±5.3. The patellar tendon was examined on a T2 MR-scanner (GE, Discovery MR750, 3.0T) in a hospital by a radiologist. Tendon shear modulus was quantified by a Supersonic elastographic imaging system (Xplore Aix-en-provence, France) with the knee supported at 30° and 60° of flexion (knee extension =0 degree) by a research assistance. The study was conducted from October 2017 to April 2018. The activity-related pain was enquired using verbal analogue scale. Spearman correlation coefficient tests were conducted.

### **RESULTS**

Significant correlation between water content and tendon stiffness was detected at 30° ( $\rho = 0.63$ ,  $p = 0.039$ ) and 60° ( $\rho = 0.74$ ,  $p = 0.037$ ). A higher intensity of activity related pain was associated with greater percentage of water content ( $\rho = 0.9$ ,  $p = 0.005$ ).

### **DISCUSSION**

MRI detected water content is associated with tendon stiffness and intensity of activity-related pain in male athletes.

## **P18: PATELLAR TENDON COMPLIANCE IS ASSOCIATED WITH HOP DISTANCE IN MALE BUT NOT FEMALE ATHLETES**

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### **INTRODUCTION:**

The patellar tendon is an energy-storing tendon that not only transmits muscle-derived forces that produce joint motion, but also stores and releases energy like a spring, which has the potential to enhance power and efficiency. A compliance tendon can store more energy but stiffen tendon can better transmit muscle force. The effects of tendon stiffness on sport performance has not been determined.

### **METHODS:**

Thirty-three (12 male) jumping athletes were recruited from a regional sports training centre with mean age of 20.6±2.4. They were screened for clinical symptoms of patellar tendinopathy, anterior knee pain, meniscus or ligamentous injuries in a sport hospital. Tendon shear modulus (an index of tendon stiffness) was quantified by Supersonic Elastographic imaging system with the knee flexed at 60°. 3-single-legged hop distance was measured and normalized with body weight and height. Pearson product correlation coefficient tests were conducted

### **RESULTS**

In healthy male athletes, correlations were detected between tendon shear modulus and normalized hop distance ( $p = -0.59$ ;  $p = 0.056$  and  $p = -0.79$ ,  $p = 0.036$  in the left and right knees, respectively). Such observation could not be detected in the female athletes.

### **DISCUSSION**

Tendon shear modulus as an index of tendon stiffness is related to the normalized hop distance in male athletes. Gender specific strategies may be used for hopping. This might be one of the causes that male jumping athletes is more prone in having patellar tendinopathy than female. For male athletes, a compliance patellar tendon enhances hopping performance.

### **P19: NEOVASCULARIZATION IN PATIENTS WITH ACHILLES TENDINOPATHY: IS SURFACE AREA QUANTIFICATION A RELIABLE METHOD?**

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#### **Introduction:**

Neovascularization is present in patients with Achilles tendinopathy. Novel treatment options are developed to target these neovessels. Clinical follow-up after these treatments includes the degree of ultrasonographically-detected neovascularization using Doppler flow. A frequently used measure is the semi-quantitative Öhberg score but this measure has limitations. A novel surface area quantification (SAQ) method has been developed. The purpose of this research is to evaluate the interobserver reliability of these two ultrasound methods in patients with chronic midportion Achilles tendinopathy.

#### **Methods:**

Patients with midportion Achilles tendinopathy with symptom duration  $\geq$  two months were enrolled in this cross-sectional study. Two observers independently examined the level of ultrasonographical neovascularization in immediate sequence. With the SAQ method, the fraction of colored pixels (%) in the color box was determined during power Doppler ultrasonography. With the Öhberg score, the ultrasonographically-detected neovascularization was graded from 0 to 4. We calculated the intra-class correlation coefficient (ICC), standard error of measurement (SEM) and minimal detectable difference (MDD) to evaluate the interobserver reliability.

#### **Results:**

A total of 32 patients were included in the study. The ICC of the SAQ method exceeded the ICC of the Öhberg score (0.85 versus 0.65;  $p < 0.01$ ). SEM and MDD of the SAQ were respectively 6.4% and 17.8%. SEM and MDD of the Öhberg score were respectively 0.55 and 1.52.

#### **Conclusions:**

The SAQ method is more reliable than the Öhberg score in quantifying neovascularization grade in Achilles tendinopathy. Therefore, this novel method should be applied in future research projects using ultrasonographically-detected neovascularization outcomes.

### **P20: DOES THE ACHILLES TENDON RESPOND TO A GAME OF RUGBY: ULTRASOUND TISSUE CHARACTERISATION STUDY**

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**Background:** The Achilles tendon has been identified to undergo transient changes in response to a game of Australian Rules football, it is currently unknown if the Achilles tendon undergoes the same changes in response to other sports.

**Aims:** To determine whether the load associated with a game of professional rugby alters the structure of the Achilles tendon in professional rugby players.

**Methods:** Bilateral Achilles tendon structure was assessed using Ultrasound tissue characterisation (UTC) in 23 professional rugby players, comparison of the four UTC echo types were made at baseline (pre-match) and at 48hr and 120hr post-game. Game load was quantified using GPS data.

**Results:** The study found an overall increase in echotype II [mean (standard deviation)] from pre-game: [33.51% (3.1)] to 48hr post-game: [33.74% (3.5)] and 120hr post-game: [35.02% (2.5)]. The change at 120hrs was significant ( $p = 0.013$ ). No other significant change was observed. Players with a history of tendinopathy ( $N = 8$ ) did not have the same response to load as healthy players. Players with no previous history of tendinopathy had an increase from 33.96% to 35.89% echotype II ( $p = 0.01$ ) from pre-game to 120 hours post-game.

**Conclusions:** Loads associated with a game of professional rugby did not appear sufficient to bring about transient changes in Achilles tendon structure, however game and training loads were. Increases in echo type II did not occur in individuals with Achilles tendinopathy despite similar total load. It is unknown if this is a feature that leads to tendinopathy or occurs as a result of tendinopathy.

### **P21: VALIDATION OF ULTRASOUND TISSUE CHARACTERISATION IN HUMANS**

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**Introduction:** Ultrasound imaging is useful for identifying tendinopathy but it is impossible to quantify tendon structure, this causes problems with clinical research and management. Ultrasound tissue characterisation (UTC) has been identified as a potential tool for quantifying tendon structure but has not been validated against human tissue. In this study we examined how UTC compares to human tissue structure.

**Methods:** The Achilles tendon from two embalmed cadavers was prepared by removal of all superficial



connective tissue. 50mm needles were inserted into the ventral aspect of the tendon perpendicular to fibre orientation. A UTC scan was then completed and cotton thread was then threaded into the needles and the needle pulled through leaving the thread in situ. At this stage the Achilles tendon was frozen and sectioned in the transverse plane at thicknesses of 30µm. The histologic sections were then stained with Horseradish peroxidase labelled antibodies, which allowed for later staining, to identify the different collagen types, this was matched with appropriate 0.2mm UTC image. Visual inspection used a grid analysis to determine area covered by type III collagen.

**Results:** A total of 12 histologic samples were directly correlated to the UTC image. Type III collagen was closely correlated to the type III echo observed on UTC aging ( $r=0.884$ ,  $p\text{ value}=0.00006$ ).

**Conclusions:** There is sufficient evidence to indicate that UTC is a valid tool for use in humans. This close correlation of echotype III to collagen III indicates that structural differences in collagen type can be identified with UTC imaging.

## **P22: BILATERAL CHANGES IN TENDON STRUCTURE OF PATIENTS DIAGNOSED WITH UNILATERAL ACHILLES AND PATELLAR TENDINOPATHY**

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**Introduction** Changes in tendon structure are commonly seen in patients with unilateral Achilles (AT) or patellar (PT) tendinopathy but might also be present in the asymptomatic side, indicating a higher risk for developing symptoms. The aim of this study is to compare tendon structure of the symptomatic side with the asymptomatic side in AT and PT patients and controls subjects.

**Methods:** A total of 47 patients with unilateral AT (16 insertional and 31 midportion) and 36 with unilateral PT were included. For the control group, a total of 18 Achilles tendon and 25 patellar tendons were scanned. Tendon structure was assessed using UTC, which quantifies tendon organization dividing the structure into four different echo-types (I-IV).

**Results:** We found significant differences in echo-types I, III and IV between symptomatic/asymptomatic side and controls. No significant differences were observed in echo-type II. Additionally, for different tendinopathy locations, we observed a significant difference at the symptomatic side compared to the asymptomatic side. In the insertional AT tendon portion, the symptomatic side showed higher percentage of echo-type III. For the midportion AT, symptomatic side showed less percentage of echo-type I and higher percentage of echo-types III and IV. For the patellar tendon, symptomatic side showed higher percentage in echo-types III and IV. All differences were higher than the minimal detectable changes.

**Conclusion:** Although patients refers unilateral symptoms, both tendon structures are compromised. These results highlight the importance of monitor both symptomatic and asymptomatic tendon structures since tendon abnormalities represent a risk for developing tendon symptoms.

## **P23: SUBSTANTIATING THE USE OF ULTRASOUND TISSUE CHARACTERIZATION IN THE ANALYSIS OF TENDON STRUCTURE**

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**Introduction:** Ultrasound tissue characterization (UTC) is a promising imaging modality that quantifies tendon structure and divides it in four different echo-types based on tissue quality (I-IV). This technique has received attention in both research and clinical practice of tendon injuries. The aim of this systematic review was to determine the role of UTC in diagnosing, predicting and monitoring tendon injuries.

**Methods:** Two independent assessors performed a systematic electronic literature search in March 2018. All scientific literature concerning the use of UTC in tendon (injuries) was collected. Of the studies included, the following data were extracted: UTC scanning and analysis methods, results and practical implications of UTC use.

**Results:** A total of 22 studies, 17 investigating the Achilles tendon, 3 the patellar tendon and 2 both Achilles and patellar tendons were included. Based on the studies investigating the Achilles tendon, UTC is capable of detecting changes in tendon structure. However, these changes are not predictive of the development of symptoms. Additionally, studies showed UTC can detect changes in tendon structure as consequence of load or treatment, however these changes showed no association with clinical symptoms. The results concerning the patellar tendon are inconclusive. In general, different methods of patient positioning, UTC scanning and UTC analysis were used.

**Conclusion:** UTC shows it can detect changes in, especially, Achilles tendon structure. We recommend more research, specifically investigating the patellar tendon and UTC's association with other outcomes. Moreover, we

recommend the development of a standardized protocol on the methods of UTC measurement and analysis.

#### **P24: EPIDEMIOLOGY OF PATELLAR TENDINOPATHY IN CRICKET: HIGH PREVALENCE OF STRUCTURAL CHANGES AMONG ASYMPTOMATIC FAST BOWLERS**

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**Background:** There is no literature describing Patellar Tendinopathy (PT) prevalence in elite cricket, a sport involving up to five consecutive, eight hour days of tendon loading exercise including running and jumping (bowling), squatting (wicket-keeping/fielding) and lunging (batting). Tendon structural abnormalities are a risk factor for progression to symptomatology.

**Aim:** To investigate the prevalence of PT and asymptomatic structural changes on imaging (Ultrasound Tissue Characterisation, UTC) among English National cricketers.

**Methods:** Clinical and UTC imaging data was obtained on elite national players (N=58, 100% male, mean age =20.7±3.7) attending pre-season profiling.

**Results:** Eight players (14%) had a current clinical diagnosis of PT, and 4 additional players had a previous history, giving a 21% lifetime history of PT. PT was more prevalent among fast-bowlers (N=9/35) followed by specialist batsmen (N=2/8), spin-bowlers (N=1/11) and wicketkeepers (N=0/4). 10/99 (10%) tendons without a history of pain showed structural abnormalities on imaging; 8/10 of these were among fast bowlers, 5 of whom did not have contralateral tendon pain nor structural abnormality.

**Conclusions:** The overall prevalence of PT in elite English cricket appears similar to that reported in elite soccer and rugby. However, prevalence of both symptomatic and asymptomatic structural abnormalities appears over-represented in fast bowlers, likely related to high mechanical forces involved in fast bowling. Asymptomatic fast bowlers should be targeted for periodic PT screening including imaging, with potential subsequent risk factor modification to mitigate risk of symptomatology and performance impact.

#### **P25: DOES REPORTING OF IMAGING FINDINGS AFFECT PATIENT'S PERCEPTION OF TREATMENT EFFICACY IN ACHILLES TENDINOPATHY?**

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**Background:** Imaging may aid in the diagnosis and management of Achilles tendinopathy. However, wording used in imaging reporting has been shown to effect patients comprehension and perceived severity of the injury. The aim of this study was to investigate whether the reporting of imaging findings after treatment alter patient outcomes and perception of treatment efficacy.

**Methods:** Participants were randomised into receiving one of two imaging reports four-weeks following an exercise trial; 1) a standard imaging report, or 2) an evidence-based report decatastrophising imaging findings. Eight-weeks following the completion of the exercise trial, a one-on-one education session was completed. Patient global impression of change (PGIC), Tampa scale of Kinesiophobia (TK-11) were completed at all time-points. Participants rated the importance of imaging findings after receiving the imaging report and one-on-one interview.

**Results:** 31 participants provided consent and were randomised. No change in PGIC and TK-11 was observed over time or by allocation of imaging report. A significant decrease in patients perception on the importance of imaging were to their ability to be physically active was observed over time (5±4 compared to 2±7.8, median±IQR), but this was not affected by the type of imaging report.

**Discussion:** This study demonstrated that patients rate their imaging moderately important to their experience of pain or ability to be physically active. Reporting of imaging findings does not alter patient's perception of treatment efficacy. Future studies are needed to ascertain whether specific wording in imaging reports impact patient outcomes or patients perception of health.

#### **P26: CHARACTERISING THE FUNCTIONAL EFFECTS OF PROTEOGLYCAN AND ANGIOGENESIS GENES ON ACHILLES TENDINOPATHY RISK**

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**Introduction:** Polymorphisms within genes encoding proteoglycans (*BGN*, *DCN*) and the angiogenesis protein *VEGFA*, were previously implicated in Achilles tendinopathy. However, the biological mechanism through which these genes may influence susceptibility remains to be elucidated. Therefore, this study aims to investigate the potential functional effect of these loci on relative gene and protein expression levels using an *ex vivo* model.

**Methods:** Fourteen healthy participants were classified according to their genetic risk profile as being reduced, unknown or increased susceptibility based on previous genotyping data. Each participant donated a skin biopsy from which primary fibroblast cell lines were established. Messenger RNA expression and protein levels for the genes of interest were measured at baseline and after TGF-1 $\beta$  treatment, using RT-PCR and western blot, respectively.

**Results:** Significant differences were noted at baseline and after TGF-1 $\beta$  treatment. At baseline, mRNA expression was significantly higher in the reduced susceptibility group compared to the risk group for both *BGN* (reduced: 1.13 arbitrary units (AU), n=8; increased: 0.46AU, n=10; p<0.001) and *VEGFA* (reduced: 1.02AU, n=8; increased: 0.52AU, n=10; p=0.001). Additionally, relative *VEGFA* expression was significantly higher in the reduced risk group in response to TGF-1 $\beta$  treatment (reduced: 3.43AU, n=8; increased: 2.45AU, n=10; p=0.001).

**Discussion:** These novel findings provide preliminary evidence highlighting the biological significance of these genes on injury risk. Further analysis of the protein expression levels and correlation to the relative gene expression is currently underway. Collectively, these results provide evidence for a biological hypothesis of the contribution of these loci to injury risk.

## **P27: ALARMIN S100A8 AND S100A9 MODULATE THE INFLAMMATORY MICROENVIRONMENT IN EARLY TENDINOPATHY**

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Alarmins S100A8 and S100A9 are endogenous molecules induced in response to environmental triggers and cellular damage. The molecular mechanisms that regulate inflammatory pathways in tendinopathy are largely unknown therefore identifying early immune effectors is essential to understanding the pathology. Based on our previous investigations highlighting tendinopathy as an alarmin mediated pathology we sought evidence of S100A8/A9 expression in a human model of tendinopathy and thereafter, to explore mechanisms whereby S100 proteins may regulate release of inflammatory mediators and matrix synthesis in human tenocytes. Immunohistochemistry and quantitative RT-PCR showed S100A8/A9 expression was significantly upregulated in tendinopathic tissue compared with control. Furthermore, treating primary human tenocytes with exogenous S100A8/9 significantly increased protein release of IL-6, IL-8, CCL2 and CCL20; however, no alterations in genes associated with matrix remodelling were observed at a transcript level. The presence of S100A8/A9 in tendinopathic lesions suggests expression is upregulated in response to cellular damage. We propose S100A8/A9 participate in early pathology by modulating the stromal microenvironment and influencing the inflammatory profile of tenocytes. S100A8 and S100A9 may participate in a positive feedback mechanism involving enhanced leukocyte recruitment and release of pro-inflammatory cytokines from tenocytes that perpetuates the inflammatory response within the tendon in the early stages of disease.

## **P28: IS AN EQUINE TENDON MODEL SUITABLE FOR STUDYING SHEAR MECHANICS WITHIN HUMAN ACHILLES TENDON?**

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**Introduction:** The human Achilles tendon receives contributions from four separate muscle bellies, adding complexity to the mechanical requirements of this high-strain, frequently injured, energy-storing structure. Differences in muscle belly activation and the material properties of the distinct tendon bundles may result in large shear forces between the bundles requiring a specialised interface. In this study we have used the equine deep digital flexor tendon (DDFT) and the accessory ligament (AL) tributary as a model to understand the relationship between separate components that contribute to a single tendon. We test the hypothesis that there is no difference in matrix composition of fascicles originating from the tendon or AL following the merging of the two structures.

**Methods:** Tissue was analysed from 11 distinct sites within the equine AL/DDFT according to their attachment profile: free, loosely-joined, or tightly-joined. Tissue was freeze-dried and water content measured, papain digested and analysed for collagen content and glycosaminoglycan (GAG) content using spectrometric methods and DNA and collagen-linked fluorescence measured using fluorometric methods.

**Results:** The AL showed higher water content, GAG content, cellularity and lower collagen-linked fluorescence than the DDFT at all sites. Water and GAG content in the AL was higher at the proximal free end than at joined sites. Cellularity of both AL and DDFT were higher at their joined sites than free ends.

**Conclusion:** The AL and DDFT retain their traits along the whole structure. We suggest this material difference produces non-uniform displacement during loading, requiring a specialised interface.

### **P29: WHOLE EXOME SEQUENCING TO CHARACTERIZE SUSCEPTIBILITY LOCI FOR TENDON INJURIES**

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**Background:** Musculoskeletal soft tissue injuries are complex phenotypes, with genetics as a proposed risk factor. Case-control association studies using the candidate gene approach have predominately been used to identify risk loci for these injuries. This study aimed to further define the genetic profile of these injuries using a multifaceted approach involving whole exome sequencing and a customized analyses pipeline. The exomes of ten exemplar asymptomatic controls and ten exemplar cases with Achilles tendinopathy were individually sequenced using a platform that included the coverage of the untranslated regions and miRBase miRNA genes.

**Results:** Approximately 200 000 variants were identified. Previous research guided the targeted analysis of *TNC* and *COL27A1*. Variants were prioritised based on a tiered filtering strategy. Four variants within the *TNC* (rs1061494, rs1138545, rs2104772 and rs1061495) and *COL27A1* (rs2567706, rs2241671 and rs2567705) were genotyped in larger cohorts for Achilles tendinopathy and ACL rupture. The CC genotype of the *TNC* rs1061494 (C/T) was significantly associated with the risk of Achilles tendinopathy ( $p=0.018$ , OR: 2.5 95% CI: 1.2-5.1). Furthermore, the AA genotype of *TNC* rs2104772 (A/T) was significantly associated with ACL ruptures in the female subgroup ( $p=0.035$ , OR: 2.3 95% CI: 1.1-5.1). Two overlapping inferred haplotypes in the *TNC* gene were also associated with the risk of Achilles tendinopathy and ACL ruptures respectively.

**Conclusion:** We provide a proof of concept for the use of a customized pipeline for the exploration of larger genomic datasets. This novel approach has generated new genetic signatures in the biology of musculoskeletal soft tissue injuries.

### **P30: EXPERIMENTAL DIABETES INDUCES STRUCTURAL AND VASCULAR CHANGES OF ACHILLES TENDONS**

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**Introduction:** This study aims to demonstrate how the state of chronic hyperglycemia from experimental Diabetes Mellitus can influence the homeostatic imbalance of tendons and, consequently, lead to the characteristics of tendinopathy. **Methods:** Twenty animals were divided into two experimental groups: control group and diabetic group constituted by rats induced to Diabetes Mellitus I. After twenty-four days of the induction of Diabetes type I, the Achilles tendon (AT) were removed for morphological evaluation, cellularity, number and cross-sectional area of blood vessel, immunohistochemistry for Collagen type I, VEGF and NF- $\kappa$ B nuclear (NLS) and nitrate/nitrite level. **Results:** The AT thickness (mm/100g) of diabetic animals was significantly increased and, similarly, an increase was observed in the density of fibrocytes and mast cells in the tendons of the diabetic group. The average number of blood vessels per field, in peritendinous tissue, was statistically higher in the diabetic group 3.39(2.98) vessels/field when compared to the control group 0.89 (1.68) vessels/field  $p=0.001$  and in the intratendinous region, it was observed that blood vessels were extremely rare in the control group 0.035(0.18) vessels/field and were often present of the diabetic group 0.89(0.99) vessels/field. The immunohistochemistry analysis identified higher density of type I collagen and increased expression of VEGF as well as increased immunostaining for NF $\kappa$ B in the nucleus in Achilles tendon of the diabetic group. Higher levels of nitrite/nitrate were observed in diabetics. **Conclusions:** We conclude that experimental DM induces notable structural and vascular changes in the Achilles tendon which are compatible with the process of chronic tendinopathy.

### **P31: APOLIPOPROTEIN A1 DISTRIBUTION PATTERN IN THE HUMAN ACHILLES TENDON**

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Metabolic factors such as cholesterol appear to play an important role in the development of Achilles tendinopathy. There is, however, no morphologic proof explaining the link between high cholesterol and tendinopathy. As apolipoprotein A1 (Apo-A1) is essential for reverse cholesterol transport, it may be related to

cholesterol overload in tendon. Nothing is known about Apo-A1 expression in tendon tissue. We examined the distribution of Apo-A1 protein in biopsies from normal and tendinopathy-affected human Achilles tendons, and APOA1 mRNA production from cultured human hamstring tenocytes. Specific immunoreactions for Apo-A1 were detected. The tenocytes showed specific Apo-A1 immunoreactions. These reactions were usually distinct in the tendinopathy specimens. While the tendinopathy specimens often showed granular/small deposit reactions, the slender tenocytes of control specimens did not show this pattern. The magnitude of Apo-A1 immunoreactivity was especially marked in the tendinopathy specimens, as there is a high number of tenocytes. Reactions were also seen in the walls of blood vessels located within the tendon tissue proper of both the normal and tendinopathy tendons and within the peritendinous/ fatty tissue of the tendinopathy tendons. The reactions were predominantly in the form of deposit reactions within the smooth muscle layer of the vessel walls. Cultured hamstring tenocytes produced APOA1 mRNA. We demonstrated the presence of Apo-A1 in human tendon tissue. This suggests there may be a link between Achilles tendinopathy and cholesterol metabolism. We hypothesize that Apo-A1 may be important for tenocyte and blood vessel function within tendons.

### **P32: LONG-TERM RESULTS OF SCRAPING PROCEDURE AND PLANTARIS TENDON REMOVAL IN CHRONIC MIDPORTION ACHILLES TENDINOPATHY**

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**Background:** Treatment with Ultrasound (US) and Color Doppler (CD)-guided minimally invasive scraping procedure and plantaris tendon removal has shown promising short-term results in patients with chronic painful midportion Achilles tendinopathy. In this study long-term outcome was analyzed.

**Methods:** 182 consecutive patients (241 tendons) that had undergone Achilles tendon scraping and additional plantaris tendon removal, were contacted by an independent assistant. Patients were asked to complete a telephone interview and to give written answers to a questionnaire including pain scores, satisfaction rate, sports activities and metabolic disease.

**Results:** Follow-up period was on average 5.8 years (range 2-13) after surgery. Altogether 110 patients (136 tendons) - mean age at surgery 52.4 (range 18-73) - could be reached and were included. 81 tendons were operated with scraping procedure alone, on 55 tendons additional plantaris tendon removal was performed. Overall, the Visual Analogue Scores (VAS) decreased from 73.7 preoperatively to 6.7 postoperatively ( $p < 0.01$ ). About 93% of patients (127 operated tendons) were satisfied with the surgical outcome. In 24 tendons (17.6%) mild pain occasionally occurred, but did not prevent from full daily tendon loading. The duration between surgery and follow up did not impact the clinical outcome and satisfaction rate. No differences in outcome were found between men and women and between scraping alone compared to scraping with plantaris removal.

**Conclusion:** The good clinical outcome and high satisfaction rate of US+CD-guided surgical scraping and plantaris removal in patients with chronic midportion Achilles tendinopathy remain constant in short and long-term follow ups.

### **P33: RISK FACTORS FOR ACHILLES TENDINOPATHY IN RUNNERS; A LARGE PROSPECTIVE COHORT STUDY**

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**Introduction** - Achilles tendon injury (ATI) is frequent in runners and results in a long symptom duration. The lifetime risk of an ATI is 52% in running athletes and it hampers return to health-promoting activities. There is only limited evidence for biomedical risk factors associated with ATI as a result of methodological study limitations. Consequently, our understanding of these risk factors is limited.

**Methods** - We designed an observational cohort study. Runners that registered for running events (5-42 km) in the Netherlands were eligible. Inclusion criteria were: age  $\geq 18$  years, registration  $\geq$  two months before the event, Dutch speaking and e-mail access. The digital baseline questionnaire consisted of (1) demographics, (2) training characteristics, (3) previous participation in events, (4) lifestyle and (5) previous running-related injuries. All participants received three follow-up questionnaires until one month after the event. The primary outcome measure was a self-reported ATI. To study the relationship between baseline variables and ATI, logistic regression analyses were performed.

**Results** - In total 2378 runners were included in the trial and 100 runners (4.2%) sustained an ATI in the study period. None of the training-related factors were independently associated with an ATI. Independent risk factors for sustaining an ATI were male sex (OR=1.6,  $p=0.046$ ), use of a training schedule (OR=2.0,  $p=0.006$ ), Use of sport compression socks (OR=1.7,  $p=0.03$ ) and an ATI in the preceding 12 months (OR=6.6,  $p < 0.001$ ).

**Conclusions** - This unique and largest observational study in runners shows a number of new modifiable and non-

modifiable risk factors for ATI. Training factors at event registration are not associated with ATI risk.

### **P34: BEST PRACTICE IN MANAGEMENT OF PLANTAR HEEL PAIN: INCORPORATING SYSTEMATIC REVIEW WITH EXPERT CLINICAL REASONING**

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Introduction: We performed a comprehensive evidence synthesis to guide Plantar Heel Pain (PHP) management from systematic review and interviews with world experts.

Methods; Six databases were searched (-11/2017) for high-quality RCTs with low bias risk. Meta-analysis were completed where possible, and findings synthesised with semi-structured interview data from 14 experts (5 countries; 3 professions; 10 cases/month).

Results: 37 studies were synthesised with 6 qualitative themes and 47 sub-themes. Education was a strong interview feature with footwear advice and load management central to treatment adherence and success. Short- and medium-term shock wave therapy efficacy was a salient joint finding. Custom orthoses are ineffective, experts prescribing these sparingly. Cortisone injection was not supported by evidence, but variably included in experts' treatment paradigms. Exercise therapy featured strongly in the interviews, with thematic tensions between strengthening, stretching and load management and no supporting high-quality studies. Surgical evidence was absent from the review, and minimally represented in decision making paradigms. Activity level, age and body mass sub-groups were strong interview findings but absent from RCT design or secondary analysis. Combining interventions to mimic clinical decision making was a research priority. There was moderate evidence of efficacy for a range of single study interventions that did not feature strongly in experts' paradigms.

Conclusion: Shock wave therapy should be adopted into treatment pathways. Various interventions should be discarded or only used in certain circumstances. Robust evidence about sub-grouping, clarity about optimal rehabilitation and intervention combinations that reflect clinical reasoning are important requirements for future work.

### **P35: FROM ACHILLES TENDINOPATHY TO ACHILLES TENDON RUPTURE: A COMPARISON OF PATIENTS IN TWO INDEPENDENT COHORTS.**

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Introduction: Achilles tendinopathy (AT) and Achilles tendon rupture (ATR) are common tendon injuries resulting in functional impairments and a prolonged absence from sport participation. It has been proposed that AT could lead to ATR. Despite this proposal, it is unknown which AT patients progress to ATR. The aim of this study was to compare and contrast the patient characteristics between AT and ATR patients.

Methods: A comparison was made between two independent observational prospective cohort studies, consisting of either AT or ATR patients. A similar baseline questionnaire and medical status were used to collect data on patient characteristics (demographic, lifestyle and medical).

Results: 38 AT (13 females; 25 males) and 24 ATR (11 females; 13 males) patients were included. Mean BMI was 27.6kg/m<sup>2</sup> for AT compared to 25.3kg/m<sup>2</sup> for ATR patients (p=0.02). Mean age was similar in both groups (44 (AT) vs 40 (ATR) years) (p=0.15). Fewer AT patients (53%) participated in sports than ATR patients (83%) (p=0.016). Median duration of sports was shorter for AT than ATR patients (1.0 vs 3.0 hours/week) (p=0.015). AT patients tended to practice different sports than ATR patients. 25% of ATR patients had previous Achilles tendon complaints.

Conclusion: Although AT and ATR patients were overweight, ATR patients were less sedentary probably due to ATRs resulting from sport trauma. A large portion of ATR patients had Achilles tendon complaints prior to ATR. More, larger, prospective studies are needed to evaluate the characteristics influencing the progression from AT to ATR.

### **P36: THE ROLE OF INFLAMMATION IN ACHILLES TENDINOPATHY: INTERLEUKIN-6 LEVELS DROP AFTER PHYSIOTHERAPEUTIC INTERVENTION**

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The role of inflammation in chronic tendinopathies is highly debated. For many years, the disease was considered to be mainly degenerative. However, recent research indicates that chronic inflammation may be a feature of

Achilles tendinopathy. Thus, the aim of this study was to investigate, if plasma levels of the inflammatory cytokine Interleukin-6 (IL6) are elevated in patients with chronic Achilles tendinopathy and if IL6 levels are affected by treatment, duration of symptoms or anatomical localization.

Male patients with chronic insertional (n=11) or mid-portion (n=11) Achilles tendinopathy were subjected to a physiotherapeutic intervention for 12 weeks. VISA-A scores and blood plasma IL6 levels were determined before and after the intervention phase.

The physiotherapeutic intervention led to improved pain and functionality. This is represented by a significant VISA-A score increase from 56±14 points at baseline to 75±19 points after the intervention. Plasma IL6 levels decreased significantly from 2.7±1.7 ng/l at baseline to 2.0±0.7 ng/l after the intervention period. IL6 levels decreased from 3.7±2.1 to 2.0±0.9 ng/l in 10 patients (7 insertional and 3 mid-portion), did not change (1.8±0.6 ng/l) in 7 patients (3 insertional and 4 mid-portion), and increased from 1.8±0.5 to 2.2±0.6 ng/l in 5 patients (1 insertional and 4 mid-portion).

At baseline, IL6 levels were elevated in some but not all patients with Achilles tendinopathy. The anatomical location may contribute to elevated IL6 levels. Inflammation appears to play a role in the progression of Achilles tendinopathies in some patients, making IL6 a potential target for therapeutic interventions in this subgroup.

### **P37: CHARACTERIZATION OF THE BURSA SUBACROMIALIS AND ITS CORRELATION TO THE SEVERITY OF SSP TEAR**

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The bursa subacromialis represents the gliding structure between the supraspinatus (SSP) tendon and the acromion. Although the bursa is related to shoulder pain, its role on tendon healing and the development of tendon pathologies is still under debate. This project aims on the histological, molecular and cellular characterization of bursa tissue and the correlation to the severity of SSP tear.

Bursa samples were collected from 15 patients with SSP tear (12 with distinct bursitis) and from five patients with shoulder instability (healthy control). Bursitis samples from patients with SSP tear histologically showed a thickened synovial cell layer, large amounts of vessels (αSMA) and immune cells (CD45<sup>+</sup>), chondral metaplasia (alcian blue), fibrosis, fatty infiltration and oedematous tissue. RNA analysis of bursitis tissue (n=12) revealed a significantly upregulated expression of the inflammatory markers TNF-α and IL10 compared to the healthy control. Other inflammatory markers (IL1β, IL6, TGFβ1), markers for pain (COX2, PENK) or innervation (PGP9.5, GAP43, MIF) were present in bursa tissues but without significant differences between the groups. Spearman correlations revealed moderate positive correlation between COX2, PGP9.5, GAP43, MIF, IL1β and IL6 expression with the SSP retraction, tear size, and/or muscle fatty infiltration. Isolated bursa cells showed a stem cell phenotype (FACS analysis), Colony formation and multipotent differentiation into the osteogenic, adipogenic and chondrogenic direction.

These results prove that bursa tissue is an innervated as well as inflammatory and cellular active tissue, which might impact tendon healing as shown by the correlation of bursa characteristics with the severity of tendon tear.

### **P38: KINETIC CHAIN STRENGTH AND PSYCHOSOCIAL ASPECTS IN RECREATIONAL RUNNERS WITH AT: A CASE CONTROL STUDY**

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Introduction: Achilles tendinopathy (AT) is a prevalent injury in running sports. Muscle weakness and pain beliefs have been suggested to be associated with AT. The aim of this case-control study was to investigate factors that discriminate the presence of AT among active participants in a multivariate model.

Materials and method: Thirty-one active male who ran at least once per week were recruited, including 17 with AT and 14 healthy active controls. Participants completed five questionnaires related to Achilles tendon function, activity and psychosocial aspects (VISA-A, IPAQ, ATBQ, TAMP, PASS20) and performed six lower limb strength tests (standing calf raises, seated calf raises, leg extension, leg curl, hip abduction, hip extension) and two ankle flexibility tests (knee extended, knee bent) in a randomised order. A forward stepwise logistic regression analysis to identify discriminating factors for the presence of AT was performed.

Results: Runners with AT had lower seated calf raise strength (16% lower, large effect size, SMD=1.29 (95%CI 0.51-2.07) and showed exaggerated altered fear-avoidance beliefs based in ATBQ questionnaire (31% higher, medium effect size, SMD=0.98 (95%CI 0.23-1.73) compared to healthy controls. The rest of the included outcomes were not associated with AT.

Conclusion: Our cohort of runners with AT had soleus and long ankle flexor muscle dysfunction and adverse beliefs about Achilles tendon pain. We recommend that clinical assessment incorporates these factors and are considered as therapeutic targets in future rehabilitation efficacy research.

### **P39: TIME COURSE CHANGES IN ACHILLES TENDON GEOMETRY AND SELF-REPORTED PAIN IN MID-PORTION ACHILLES TENDINOPATHY**

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**Abstract Introduction:** Tendon pain and geometry are altered following the onset of mechanical loading. The purpose of this study was to examine the time course of changes in 3D free AT geometry and self-reported pain in mid-portion Achilles tendinopathy tendons following the onset of repeated sub-maximal isometric contractions.

**Abstract Methods:** Tendinopathic (n=10) and matched healthy tendons (n=10) were scanned at rest and during ten 30 second sub-maximal voluntary isometric contraction using a freehand three-dimensional (3D) ultrasound technique. Average free tendon cross-sectional area (CSA), longitudinal strain and volume were subsequently computed. Self-reported pain during each contraction was also recorded.

**Abstract Results:** The tendinopathic free AT had a significantly greater average CSA and volume at rest relative to the control tendons. Under load, the tendinopathic tendon experienced greater longitudinal strains and a greater reduction in tendon CSA compared to the control tendons. Tendon pain, average CSA and volume decreased from contraction 1 to 3 in the tendinopathic tendons.

**Abstract Conclusion:** The reduction in self-reported pain during submaximal isometric loading of the Achilles tendon occurs on a similar time course to load-induced changes in 3D tendon geometry. These findings point to the possibility that alterations in 3D tendon geometry including a reduction in tendon volume following the onset of loading, could contribute to the accompanying reduction in self-reported pain.

### **P40: CLINICAL AND PSYCHOLOGICAL FEATURES IN POSTERIOR TIBIAL TENDON DYSFUNCTION: PRELIMINARY FINDINGS**

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**Introduction:** Posterior tibial tendon dysfunction (PTTD) is associated with pain during activities that load the tibialis posterior tendon and limited participation in daily and physical activities. The presence of altered foot posture and function have been established in the literature yet little is known about factors such as quality of life and psychological features in PTTD. The aim of this preliminary study is to investigate clinical and psychological measures in individuals with PTTD compared to asymptomatic controls.

**Methods:** This cross-sectional study compares females with PTTD (currently n = 14, age: 40±16; BMI: 23±3) and asymptomatic controls (n = 20, age: 42±17, BMI: 23±5). PTTD diagnosis was made clinically based on medial foot/ankle pain plus one or more of: tenderness on palpation or swelling of the posterior tibial tendon or pain/difficulty with resisted plantarflexion inversion or single leg heel raise. Clinical measures of foot posture, function, range of motion and strength at the foot and hip and self-reported psychosocial measures were assessed. Preliminary between group differences were explored using a MANOVA and standardised mean differences (SMDs) were calculated to evaluate effect sizes.

**Results:** Preliminary results suggest large effects (SMD > 1.0) for poorer self-reported function, quality of life, functional performance of stairs, greater pronated foot posture and lower heel raise endurance in PTTD compared to controls (p<0.01). Data collection is still ongoing and results will be updated at the conference

**Conclusion:** Participants with PTTD appear to have poorer physical function and reduced quality of life than those without this condition.

### **P41: INJURIES AND LOWER EXTREMITY TENDINOPATHIES IN YOUTH BASKETBALL: A PROSPECTIVE COHORT STUDY**

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**Background/Purpose:** To evaluate injury rates using an “all complaints” injury definition and specifically assess the season prevalence of patellar tendinopathy (PTP) and Achilles tendinopathy (ATP) in youth basketball players.

**Methods:** This was a prospective cohort study. A total of 506 youth basketball players (64 teams) (61% male) participated. Players were observed through one competitive high school and club basketball season to record “all complaint” injuries—defined as any basketball-related physical/musculoskeletal complaint irrespective of the need for medical attention or time-loss. In addition, PTP and ATP were specifically captured using an adapted Oslo



Sports Trauma Research Centre questionnaire.

**Results:** A total of 429 independent injuries were reported by 288 players (57%), equivalent to an injury rate (IR) of 84.8 injuries/100players/season (95%CI: 81.4–87.8); 83.4 in males (95%CI: 78.8–87.5) and 86.7 (95%CI: 81.4–91.2) in females. The IR of acute onset injuries was 47.2 (95%CI: 42.8–52.7) and overuse injuries was 37.5 (95%CI: 33.3–41.9%). The season prevalence of PTP was 19% (95%CI: 15%–22%); 22% (95%CI: 18%–27%) in males and 13% (95%CI: 9%–19%) in females. Season Prevalence of ATP was 4% (95%CI: 3%–7%); 4% (95%CI: 2%–7%) in males and 5% (95%CI: 2%–8%) in females.

**Conclusions:** Using an “all complaint” injury definition, injury rates in youth basketball are higher than previously reported with high occurrence of overuse injuries. Patellar tendinopathy is common among youth basketball players. Injury prevention interventions are warranted to mitigate the burden of both acute and overuse injuries.

**Acknowledgments:** This study was funded by the NBA/GE through the Orthopaedics/Sports Medicine Collaboration Grant on Tendinopathy.

#### **P42: DIAGNOSTIC ACCURACY OF A SELF-REPORT MEASURE OF PATELLAR TENDINOPATHY IN YOUTH BASKETBALL**

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**Background/Purpose:** Engaging clinicians for diagnosis of patellar tendinopathy in large surveillance studies is often impracticable. A self-report measure, the Oslo Sports Research Trauma Centre patellar tendinopathy (OSTRC-P) Questionnaire, an adaptation of the OSTRC Questionnaire may provide a viable alternative. Study aimed at evaluating the diagnostic accuracy of the OSTRC-P Questionnaire in detecting patellar tendinopathy in youth basketball players when compared to clinical evaluation.

**Methods:** This was a prospective diagnostic accuracy validation study. Following the Standards for Reporting of Diagnostic Accuracy Studies guidelines, 208 youth basketball players (aged 13–18 years) were recruited. Participants completed the OSTRC-P Questionnaire (index test) prior to a clinical evaluation (reference standard) by a physiotherapist blinded to OSTRC-P Questionnaire results. Sensitivity, specificity, predictive values (PVs), likelihood ratios (LRs) and posttest probabilities were calculated. Linear regression was used to examine the association between OSTRC-P Questionnaire severity score and patellar tendinopathy severity rating during single leg decline squat (SLDS).

**Results:** The final analysis included 169 players. The OSTRC-P Questionnaire had a sensitivity of 79% (95%CI: 65%, 90%), specificity of 98% (95%CI: 94%, 100%), positive PV of 95%, negative PV of 92%, positive LR of 48 and negative LR of 0.21. The posttest probabilities were 95% and 8% given positive and negative results, respectively. A positive association was found between OSTRC-P Questionnaire and SLDS rating [ $\beta = .08$  (95%CI: .03, .12) ( $p = .001$ )].

**Conclusions:** The OSTRC-P Questionnaire is a valid alternative to clinical evaluation for self-reporting patellar tendinopathy in settings involving youth basketball players.

**Acknowledgments:** Funding-NBA and GE Healthcare

#### **P43: BEST PRACTICE MANAGEMENT OF MID-PORTION-ACHILLES-TENDINOPATHY: INCORPORATING LEVEL 1 EVIDENCE WITH EXPERT CLINICAL REASONING**

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**Introduction:** We need robust guidelines for Mid-portion Achilles tendinopathy (MPAT) management, which we aimed to develop.

**Methods:** Six databases were searched (-02/2018) for RCTs for mid-portion Achilles tendinopathy. Adequately-powered, high-quality studies with low bias risk were retained. Semi-structured interviews with 14 world experts from 9 countries, 4 professions, paper output 20 per person seeing 23 cases/month (medians) were undertaken.

**Results:** 27 studies' results were synthesised with 6 emergent qualitative themes and 30 sub-themes. Key joint findings included considering athletic, active and sedentary sub-groups differently, primacy of progressive loading interventions and considering adjuncts where progression stalls. The review showed strong evidence of short term positive progressive loading effects for active and sedentary groups, and shock wave therapy in the medium term. There were moderate positive effects for progressive loading and shockwave therapy at other timepoints, as well as for hyaluronan, high volume injection and vibration therapy. No intervention demonstrated long-term effectiveness, but moderate evidence indicated no effect of orthoses, night splints or rest from sport during rehabilitation in the long term. Surgical evidence was not synthesised but expert opinion varied between being useful in recalcitrant cases to being best avoided.

Conclusion: Progressive loading and shock wave therapy demonstrate efficacy for the majority of patients in the short and medium term. Long term effectiveness studies are needed. Athletic groups should be considered differently from other groups and there is no direct evidence to guide care. Combined interventions are an important subject for future study.

#### **P44: CROSS-SECTIONAL STUDY OF SOMATOSENSORY AND PSYCHOSOCIAL FEATURES, AND CO-MORBID PAIN CONDITIONS IN SEVERE LATERAL EPICONDYLALGIA**

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**Introduction:** Lateral epicondylalgia (LE) involves substantial pain and disability, yet understanding of factors contributing to pain severity remains unclear. Although, altered sensory profiles have been reported in patients with severe LE, patients with bilateral LE or concomitant disorders were excluded from those studies. We compared presence of co-morbid painful conditions, somatosensory and psychosocial features between individuals with severe LE and those with less severe LE and healthy controls (HC).

**Method:** 140 patients with LE as their predominant pain were recruited (37% female, mean age 49 years) along with 58 HC (43% female, mean age 51 years). LE patients were sub-grouped on the basis of the Patient-Rated Tennis Elbow Evaluation (PRTEE) into severe (N=31, PRTEE $\geq$ 50) and less severe (N=109, PRTEE<50). Thermal and mechanical detection and pain thresholds locally (lateral epicondyle) and remotely (tibialis anterior), temporal summation, and conditioned pain modulation were assessed, along with PainDETECT (neuropathic-like symptoms), Nordic Musculoskeletal Questionnaire (concomitant pain sites) and psychosocial measures. Between-group effects were expressed as standardised mean differences (SMD) or relative risk (RR).

**Results:** Moderate to large effects (SMD 0.6-2.1,  $p<0.01$ ) of lower remotely measured cold pain threshold, higher pain catastrophising and lower quality of life were observed in severe LE compared to less severe LE and HC. Greater number of patients reported 3 or more concomitant pain sites in the severe than less severe group (52%vs28%, RR 1.88, 95%CI 1.19-2.96).

**Conclusion:** Patients with severe LE exhibited widespread cold hyperalgesia. Number of concomitant pain sites and psychosocial factors are also associated with severe LE.

#### **P45: WHICH RUNNERS TRANSIT FROM REACTIVE TO CHRONIC ACHILLES TENDINOPATHY? A LARGE PROSPECTIVE COHORT STUDY**

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**Background** – The reported incidence of Achilles tendon injury(ATI) in runners is approximately 4-9%.This can lead to chronic symptoms and reduced sports participation and performance. According to the continuum model, reactive tendinopathy can transit to chronic degenerative tendinopathy. However, it is unknown which patients with reactive ATI develops chronic symptoms.

**Methods** – This prospective cohort study was designed for runners that registered for a Dutch running event. Major inclusion criteria were age  $\geq 18$  years and a self-reported ATI between registration and one month after the race. A digital questionnaire regarding patient characteristics, treatments applied and running performance was sent one year after inclusion. The validated VISA-A score was also completed and dichotomized according to the fist validation study (VISA-A score of  $\geq 97$  points representing recovery) The proportion of runners with the transition to chronic ATI was calculated. To study the relationship between potential risk factors and chronic ATI, logistic regression analyses were performed.

**Results** – Of 2378 participants, 100 participants(4.2%) sustained an ATI. A total of 66 runners(66% response rate) completed the 1-year follow-up questionnaire. Persisting symptoms were reported in 31% of the runners and even 63% did not reach recovery level on the VISA-A score. Additionally, 46% of the runners changed their running habits. None of the patient characteristics or treatments applied were associated with the transition to chronic ATI.

**Conclusion** – These unique data show that a large proportion of runners experience chronic symptoms after a reactive ATI. It is currently unknown which factors lead to this chronicity.

#### **P46: ULTRASOUND-GUIDED TENDON DEBRIDEMENT EFFECTS ON PATELLAR TENDINOPATHY PAIN AND STRUCTURE: A CASE SERIES**

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Introduction:

Patellar tendinopathy is a common overuse condition. Surgery is considered after failed conservative care, with variable outcomes. Tendon biology advances have led to development of an ultrasound-guided tendon debridement procedure targeting regions with peritendinous sensory innervation. This prospective case series was designed to establish resultant medium-term clinical outcomes and tendon structure change.

Methods:

Consecutive participants with patellar tendinopathy that had failed conservative management and who had an ultrasound-guided arthroscopic (dorsal) and open (ventral) tendon debridement under local anaesthetic were recruited between 04/2016 to 6/2017. Treatment included supervised and graduated post-surgical rehabilitation. VISA-P scores were collected for clinical outcomes, ultrasound tissue characterisation (UTC) for tendon structure and adverse events were actively solicited.

Results:

19 male and 4 female participants aged (mean±sd) 28.1±8.0 years and symptom duration of 24.8±21.1 months were included. 16 were elite athletes. At six month follow up, the VISA-P score increased from 40.0±21 to 82.0±14.5 ( $d=2.4$ , 95%CI=31.7-53.1,  $p=0.01$ ). Organised echo pixels (type I+II) increased from 54.7±16.8 to 68.9±14.6 ( $d=0.7$ , 95%CI=2.1-20.9,  $p<0.01$ ) greater than the minimal detectable change of 3.4%. 21 participants returned to pre-injury activity levels, and there were no reported complications.

Conclusion:

Ultrasound-guided patellar tendon debridement for chronic patellar tendinopathy improved symptoms and tendon structure at six month follow up, without reported complications. Randomised clinical trial are warranted.

#### **P47: PATELLAR TENDINOPATHY OUTCOME PREDICTORS IN COMPETITIVE ATHLETES: A FEASIBILITY STUDY FOR A MULTI-LEVEL COHORT STUDY**

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**Introduction:** Patellar tendinopathy (PT) is a common, recalcitrant overuse disorder typically occurring in jumping athletes. We will carry out a multi-level cohort of 2000 participants to determine outcome predictors. This study is to test data collection processes, and assess validity and reliability of the questionnaire, laboratory, clinical, and imaging approaches.

**Methods:** 10 male and 8 female competitive athletes (6 with PT, 6 other knee conditions and 6 controls) were assessed twice by online survey, assisted and non-assisted at 2-7 days in a randomised order, plus structured feedback elicitation. Outcomes were measurement agreement, feedback analysis, VISA-P levels, pain map and retrospective training loads.

**Results:** Inter-measure VISA-P ICC<sub>2,1\_absolute</sub> was 0.91 (95% CI=0.75-0.97). VISA-P differed between participant groups ( $F=11.0$ ,  $\eta^2=0.6$ ). There was no order effect ( $p=0.98$ ) but a trend towards a systematic difference between assisted and non-assisted methods ( $p=0.06$ ). Pain maps were 96% matched between methods without any order effect. 75% of the PT group clearly identified the inferior patellar pole. Pain was spreading around patella with 57%. Training load recall percentage decreased until week-3 with only the 20% maintaining a training diary completing the full 6 weeks. Survey completion rate was 75%, the most common reason for cessation being survey length, lasting 30 minutes.

**Conclusions:** Online method is as effective and reliable as face-to-face. Using an amended and shorter online survey for the multi-level cohort could be appropriate with prospective training load monitoring. We will have clinical and laboratory data prior to ISTS.

#### **P48: OUTCOME PREDICTORS OF PLANTAR HEEL PAIN: A FEASIBILITY STUDY FOR MULTI-LEVEL COHORT STUDY**

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**Background:** Plantar heel pain (PHP) is the most common musculoskeletal heel pain complaint, typically with poor outcomes and high recurrence. This feasibility study aims to determine validity and reliability of the measurement tools for an 18 month multi-level cohort study of 2000 people.

**Methods**

9 females and 9 males, with equal numbers of those with PHP, other foot pain and controls were recruited to determine equivalence between assisted and non-assisted survey completion in a randomised order. Outcomes were measurement reliability, completion, feedback analysis, and pain map analysis.

#### **Result**

Foot and Ankle Outcome Score reliability were typically good or excellent (0.86-0.99) except the quality of life (0.58, 95% CI=-0.10-0.84). Survey completion rate was 73%, took 26±14 minutes, and participants reported the survey to be too long and have some repetition. There were no systematic differences due to order or method. Pain map analysis showed the centre on between midfoot and hindfoot was the most common point with 25% among of all point on the plantar aspect of the foot. Additionally, 66% of participants with PHP determined the medial aspect of hindfoot as a pain-spreading region.

#### **Conclusion**

It appears that the non-assisted online method is reliable and is feasible for wider use once completion rates have been improved by feedback. These changes should also address unacceptable FAOS QoL score variability. Biomechanical, clinical, and imaging measurements feasibility will be complete prior to ISTS 2018.

### **P49: THE EFFECTIVENESS OF ECCENTRIC-CONCENTRIC TRAINING AND ISOMETRIC CONTRACTIONS IN ACHILLES TENDINOPATHY: A CASE REPORT**

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**Abstract Introduction (purpose / background):** Many patients with Achilles Tendinopathy do not respond to eccentric training. The aim of the present case report is to find out the effect of eccentric - concentric training of gastrocnemius and soleus combined with isometric contraction of gastrocnemius and static stretching exercises of gastrocnemius and soleus on pain and disability in a patient experiencing Achilles Tendinopathy. **Abstract Methods:** A patient with unilateral Achilles Tendinopathy for 6 months was included in the present study. The patient followed a supervised exercise five times per week for 6 weeks consisting of, isometric gastrocnemius exercise, and slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus. The programme was individualized on the basis of the patient's description of pain experienced during the procedure. The VICTORIAN INSTITUTE OF SPORTS ASSESSMENT – ACHILLES QUESTIONNAIRE was used to evaluate the patient at baseline, at the end of treatment (week 6), and 1 month (week 10) after the end of treatment. **Abstract Results:** At the end of the treatment and at the follow – up there was a decrease in pain and an increase in function. **Abstract Conclusions/Discussion:** The results of the present study suggest that the combination of isometric gastrocnemius exercise, slow progressive eccentric - concentric training of gastrocnemius and soleus and static stretching exercises of gastrocnemius and soleus can produce significant improvements in terms of pain and disability in Achilles Tendinopathy.

### **P50: ISOMETRIC, ECCENTRIC - CONCENTRIC TRAINING AND LUMBO-PELVIC CONTROL EXERCISES IN CHRONIC PATELLAR TENDINOPATHY. CASE REPORT**

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**Abstract Introduction (purpose / background):** Eccentric exercises are not effective for all patients with chronic patellar tendinopathy (CPT). The aim of the present case report is to present the effect of eccentric - concentric training combined with isometric contraction and simple lumbo-pelvic control exercises on pain and disability in a patient experiencing CPT. **Abstract Methods:** A patient with unilateral CPT for 4 months was included in the present report. The patient followed a supervised exercise five times per week for 6 weeks consisting of, isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises. The programme was individualized on the basis of the patient's description of pain experienced during the procedure. The patient was evaluated using the VISA – P questionnaire at baseline, at the end of treatment (week 6), and 1 month (week 10) after the end of treatment. **Abstract Results:** At the end of the treatment and at the follow – up there was a decline in pain and a rise in function. **Abstract Conclusions/Discussion:** The results of the present trial suggest that the combination of isometric quadriceps exercise, slow progressive eccentric - concentric training of quadriceps and simple lumbo-pelvic control exercises can produce significant improvements in terms of pain and disability in CPT.

### **P51: ECCENTRIC-CONCENTRIC TRAINING COMBINED WITH ISOMETRIC CONTRACTION IN THE TREATMENT OF LATERAL ELBOW TENDINOPATHY**

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**Abstract Introduction (purpose / background):** To compare the effectiveness of eccentric training, eccentric – concentric training, and eccentric – concentric training combined with isometric contraction in the treatment of Lateral Elbow Tendinopathy (LET). **Abstract Methods:** A randomized clinical trial was carried out with 34 patients who had LET in a rheumatology and rehabilitation centre. They were randomly allocated to three groups. Group A (n=11) was treated with eccentric training. Eccentric – concentric was given to group B (n=12). Group C (n=11) received eccentric – concentric training combined with isometric contractions. All patients received five treatments per week for four weeks. Pain was evaluated using a visual analogue scale and function using a visual analogue scale and pain-free grip strength at the end of the four-week course of treatment (week 4) and one month (week 8) after the end of treatment. **Abstract Results:** The eccentric – concentric training combined with isometric contractions produced the largest effect in the reduction of pain and in the improvement of function at the end of the treatment and at any of the follow-up time points. **Abstract Conclusions/Discussion:** The eccentric – concentric training combined with isometric contractions was the most effective treatment. Future well designed studies are needed to confirm the results of the present trial.

#### P52: THE EFFECT OF VIBRATION ON TENDON MICROCIRCULATION AFTER ACHILLES TENDON REPAIR

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**Background:** Recent studies showed that tendon microcirculation was increased after application of a vibration concentrated on the Achilles tendon. Furthermore, higher levels of microcirculation soon after an Achilles repair are associated with better functional outcomes. Theoretically, the early application of a vibration may, therefore, benefit the tendon healing process. The aim of this study was to investigate the effect of vibration on tendon microcirculation after Achilles tendon repair.

**Methods:** Patients with unilateral Achilles tendon repair were recruited. Follow-up visits were conducted at the end of the first, second, third, and sixth months after the surgery. Tendon microcirculation, including total hemoglobin (THb) and oxygen saturation (StO<sub>2</sub>), was measured using a red laser probe.

**Results:** Twelve patients completed the study over the 6-month period. The average THb decreased from 19.15 to 14.22 in the vibration group and from 20.64 to 17.50 in the control group; the average StO<sub>2</sub> decreased from 68.29 to 63.79 in the vibration group and from 77.23 to 76.28 in the control group.

**Discussion:** An increased blood flow remained for the first two months and then gradually decreased. The blood flow in the vibration group decreased more than that in the control group, which may indicate more successful recovery. The StO<sub>2</sub> in the vibration group was maintained at a lower level than that in the control group. The mechanical stimulation may improve the O<sub>2</sub> delivery and uptake of the Achilles tendon. Future studies are suggested to investigate whether persistent hypervascularization may be considered a marker of pathologic scarring.

#### P53: VARIATION OF MICROCIRCULATION IN MUSCLES AND TENDONS OF LOWER EXTREMITY IN SUBJECTS WITH DIABETES MELLITUS

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**Background:** Diabetes mellitus (DM) often causes numerous complications, some of which have been found in recent years to affect the musculoskeletal system. One of the possible mechanisms is hypoxia due to microvascular impairment. However, a clear understanding of the microcirculation in the musculoskeletal system is still lacking. The aims of this study were to investigate the microcirculation in muscles and tendons during resting and isometric muscle contractions in patients with DM.

**Methods:** Patients with and without DM were recruited as the DM group and control group, respectively. For each subject, the microcirculation of the rectus femoris, medial gastrocnemius, patellar tendon and Achilles tendon during rest and isometric muscle contraction was assessed. The microcirculation included total hemoglobin (THb) and oxygen saturation (StO<sub>2</sub>) which were measured using near-field infrared spectroscopy and red laser light for the muscles and tendons respectively.

**Results:** Ten and eight subjects were recruited into the DM group and control group, respectively. The StO<sub>2</sub> in tendons were higher in the DM group, with p-values of 0.01 and 0.092 for the patellar tendon and Achilles tendon, respectively. During isometric muscle contraction, the lowest value of StO<sub>2</sub> in the medial gastrocnemius

was lower in the DM group, with a p-value of 0.026.

**Discussion:** The difference in StO<sub>2</sub> in tendons might be explained by the neovascularization, which may be similar to that seen in tendinopathy. The difference in StO<sub>2</sub> in medial gastrocnemius during muscle contraction may indicate that the local regulation of microcirculation is impaired by DM, affecting the delivery of oxygen.

#### **P54: BIOMECHANICAL CHARACTERISTICS OF THE CONCENTRIC AND ECCENTRIC EXERCISE AFTER ACHILLES TENDON RUPTURE**

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**Background:** Morphomechanical changes of the myotendinous unit in the calf muscles after an Achilles rupture, such as reduced mechanical stiffness, tendon lengthening and alterations of fascicle geometry, may lead to biomechanical changes during dynamic movements with muscle shortening and lengthening. This study sought to compare the biomechanical characteristics of legs with a unilateral Achilles tendon repair and their non-injured counterparts, which served as controls, during concentric and eccentric exercises.

**Methods:** Nine subjects with an Achilles repair performed serial one-legged full weight bearing calf raising exercises bilaterally on a wooden box, during which ground reaction forces, surface electromyography (EMG) of the lower leg muscles and Achilles tendon vibration amplitude were recorded. Average EMG amplitudes, Achilles tendon works and maximal vibration amplitudes of the non-injured and repaired legs during the concentric and eccentric phases of the exercise were calculated and compared.

**Results:** Compared to the non-injured legs, the repaired legs showed greater EMG of the *soleus and tibialis anterior muscles* during the concentric or eccentric phases of the exercise (p ranged 0.018-0.001); greater tendon vibration amplitude on the y-axis in the eccentric phase (p=0.019); and less Achilles tendon work in both phases (p <0.05).

**Discussion:** There are differences in biomechanical characteristics during dynamic movements with concentric and eccentric muscle contractions after an Achilles repair. These characteristics may be disabling *consequences of* concomitant morphomechanical changes in the calf muscles and may affect the kinematics of the ankle joint and muscle mechanics during dynamic movements when repetitive *maximal shortening and lengthening* contractions are required.

#### **P55: THE EFFECT OF VIBRATION ON FUNCTIONAL OUTCOMES AFTER ACHILLES TENDON REPAIR.**

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**Background:** Vascularization is considered to be an indicator of tendon healing. A recent study showed that a vibration intervention increases microcirculation in the Achilles tendon. Moreover, microcirculatory changes were found to be correlated with functional outcomes after an Achilles tendon repair. The present study investigated the effect of early application of vibration on functional outcomes after Achilles tendon repair.

**Methods:** Participants with unilateral Achilles tendon repair were recruited and divided into vibration and control groups. The vibration group received the vibration intervention during the second to sixth week after surgery. All participants completed the Victorian Institute of Sport Assessment-Achilles questionnaire (VISA-A) at the first, second, third and sixth month after surgery. The single heel raise test, star excursion balance test (SEBT) and one-legged hopping (OLH) test were performed at the third and sixth month after surgery.

**Results:** The VISA-A score was significantly higher in the vibration group (n=6) than in the control group (n=6) at the third and the sixth month. The heel raise index and OLH distance were also significantly higher in the vibration group, and were significantly correlated to the VISA-A score at the third month (r=0.68 with heel raise index; r=0.64 with OLH).

**Discussion:** The results showed that early vibration intervention improved a patient-reported outcome, calf muscle endurance and power output ability. This may be explained by the beneficial effect of mechanical intervention to the healing process. Therefore, early mechanical intervention during immobilization is highly recommended for Achilles tendon repair.

#### **P56: TOPICAL GLYCERYL TRINITRATE FOR THE TREATMENT OF TENDINOPATHIES: A SYSTEMATIC REVIEW**

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**Purpose:** To produce a best evidence synthesis of the clinical effects of topical glyceryl trinitrate (GTN) in the treatment of tendinopathies.

**Methods:** We examined randomised controlled trials (RCTs) comparing the effects of topical GTN with either placebo or other treatments on tendinopathy. Overall quality of each eligible study was determined based on a combined assessment of their internal validity, external validity and precision. The level of evidence for each assessed parameter was rated based on the system by Van Tulder et al. (1997) separately for short (0-8 weeks) and mid-term (12-24 weeks) results.

**Results:** A total of 10 eligible RCTs were identified including patients with tendinopathy of the rotator cuff (four), wrist extensors (three), Achilles (two), and patellar (one) tendons. Based on moderate and strong evidence, GTN appeared superior to placebo in the mid-term (>8 weeks follow up) in terms of range of movement, strength, patient satisfaction and chances of being asymptomatic with activities of daily living. In addition, there may be short and mid-term benefits associated with the use of topical GTN based on poor evidence. Patients treated with topical GTN reported a significantly higher incidence of headaches than those who received placebo.

**Discussion/Conclusions:** Treatment of tendinopathies with topical GTN for up to six months appears to be superior to placebo and may therefore be a useful adjunct to the treating healthcare professions. However further well-designed studies are warranted to provide insights into its long-term outcomes and relevance to treating chronic tendinopathies.

#### **P57: BIOMECHANICS IN INDIVIDUALS WITH ACHILLES TENDINOPATHY DURING RUNNING AND HOPPING: A SYSTEMATIC REVIEW WITH META-ANALYSIS**

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**Introduction:** Biomechanical alterations during running and hopping have been reported among people with Achilles tendinopathy (AT). The purpose of this paper was to identify and synthesise these biomechanical alterations to inform prevention and rehabilitation of AT, and future research.

**Method:** Systematic review of the MEDLINE, EMBASE, CINAHL and SPORTDiscus online databases was conducted for case control, cross-sectional and prospective studies investigating kinematic, kinetic, dynamic plantar pressures and neuromuscular activity in AT participants during running or hopping. The systematic review followed the PRISMA guidelines. Quality of the included studies was assessed with a modified version of the Downs and Black quality checklist.

**Results:** 16 studies, from which only four were considered high quality, met the inclusion criteria. Meta-analysis indicates peroneus longus and medial gastrocnemius amplitude at weight acceptance phase are decreased in shod runners with AT compared to controls. Limited evidence indicates runners with AT have increased hip forces during stance and decreased and delayed gluteal muscle activation around foot-strike compared to controls. Limited evidence related to plantar pressure measurement indicates reduced total anterior displacement of the centre of force and a more laterally directed force distribution at foot flat are risk factors to develop AT among novice runners. Limited evidence indicates leg stiffness is reduced in the affected side of individuals with unilateral AT during submaximal hopping.

**Conclusion:** There are few confirmed alterations in lower limb biomechanics during running and hopping among people with AT. However, certain impairments have been described and should be considered in rehabilitation.

#### **P58: FEASIBILITY AND RELIABILITY OF USING A HAND-HELD DEVICE TO CHARACTERIZE TENDINOPATHIC TISSUE MECHANICS.**

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**Objectives:** 1) To examine the feasibility of using the MyotonPRO digital palpation device in measuring stiffness of healthy tendon tissue. 2) Assess the reliability of stiffness measurements taken by the MyotonPRO among patients with Achilles tendinopathy.

**Design:** Experimental study.

**Methods:** The device was used to measure the difference in tendon stiffness before and after the removal of the

overlying skin and subcutaneous tissue. The stiffness of the Achilles tendon was also measured before and after competitive running races of varying distances (10, 21 and 42 km, n=66). Finally, the reliability of the MyotonPRO was assessed through comparing between-week values of recreational runners with tendinopathy.

Results: The presence of skin overlying the avian Achilles tendon had a statistically significant impact on stiffness ( $p < 0.01$ ) although this impact was of small absolute magnitude (skin:  $728 \text{ N/m} \pm 17 \text{ N/m}$ ; no skin:  $704 \text{ N/m} \pm 7 \text{ N/m}$ ). The MyotonPRO had excellent reliability for the Achilles tendon (ICC, 0.96) in healthy subjects with normal BMI. In the field study, the stiffness of the Achilles tendon tended to increase following running ( $p = 0.052$ ). The between-week reliability testing on tendinopathic subjects is ongoing, however we are seeing results similar to those of healthy participants ( $n = 4$ ; ICC, 0.99).

Conclusions: The MyotonPRO can reliably determine the transverse mechanical properties of tendon tissue in both healthy and tendinopathic people. The measured values are influenced by the presence of overlying skin, however this does not appear to compromise the ability of the device to record physiologically and clinically relevant measurements.

#### **P59: USE OF MESENCHYMAL STEM CELLS AGGREGATES WITH GELATIN HYDROGEL MICROSPHERES FOR REGENERATIVE THERAPY OF TENDON**

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##### **Introduction**

Administration of mesenchymal stem cells (MSCs) for tendon regeneration has been reported as a treatment option. Recent research has revealed that MSC aggregates with gelatin hydrogel microspheres (GMS) augment the biological functions of MSCs. We hypothesized that the aggregates would enhance regenerative therapy for tendon injury.

##### **Methods**

1. We cultured equine MSC with or without GMS and compared MSC viability after 14 days. 2. We cultured equine tenocytes in each supernatant obtained from the culture medium of MSC aggregates with or without GMS and assessed tenocyte proliferation. 3. We administered each MSC aggregate with GMS or monolayer-cultured MSCs into a contralateral equine injured tendon (five horses). The distribution of MSCs was assessed histologically after one, three, and seven days with scores; one (poor) to three (rich).

##### **Results**

1. The MSC viability with GMS was significantly higher than those without GMS ( $P < 0.05$ ). 2. Proliferation of tenocytes cultured in supernatants of aggregates with GMS was 1.2 times significantly higher than those without GMS ( $P < 0.05$ ). 3. The histological scores of aggregates-administered tendons were higher than those of tendons treated with the monolayer-cultured cells at 7 days after administration.

##### **Discussion**

The presence of GMS contributes to high MSC viability in aggregates. Paracrine effects on tenocyte proliferation by MSC aggregates with GMS appear higher than by those without GMS. Although further research is needed these data show potential improvement in MSC cell therapy of tendon injury using aggregates with GMS.

#### **P60: QUANTITATIVE ANALYSIS OF PATELLAR TENDON SIZE AND STRUCTURE IN PROFESSIONAL PLAYERS**

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**BACKGROUND:** Ultrasonographic abnormalities of the patellar tendon frequently occur in asymptomatic athletes and it is not always clear whether they precede (and may predict) the development of tendinopathy.

**OBJECTIVE:** The present study aimed to investigate by ultrasonography the prevalence of patellar tendon abnormalities in players of "pallapugno" and to establish whether structural tendon abnormalities predict tendinopathy development.

**METHODS:** Ultrasound B-mode images of the patellar tendon of both sides were acquired in fourteen throwers. Qualitative assessments of tendon structure and neovascularization and quantitative assessments of tendon thickness, cross sectional area (CSA), and echo-intensity were performed.

**RESULTS:** Qualitative assessments showed a subclinical tendinopathy of the non-dominant tendon in 5 out of 14 throwers (35% of cases), while quantitative assessments showed abnormalities of the non-dominant tendon in 8 out of 14 players (57% of cases). Echo-intensity and CSA were the quantitative variables most discriminant between asymptomatic players without structural tendon abnormalities and those with tendon abnormalities.



Two players (2 out of 8 cases: 25%) developed a clinical tendinopathy after a follow-up of six months.

**CONCLUSION:** The prevalence of subclinical tendinopathy in the non-dominant patellar tendon of professional players is high. Patellar tendon abnormalities at baseline seem to increase the risk of development of subsequent patellar tendinopathy.

#### **P61: ISOKINETIC PROFILE OF SUBJECTS WITH PROXIMAL PATELLAR TENDINOPATHY**

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**Introduction:** Patellar tendinopathy (PT) is commonly observed in jumping sports. Even if its biomechanic is somewhat explored, no information is known about their isokinetic muscle strength profile. We aimed to determine if there exists a specific isokinetic profile of patients suffering from a PT.

**Methods:** 43 patients suffering from PT were recruited. To be eligible, the patients must not have suffered from any other traumatic or micro-traumatic injury than the PT on the pathologic limb. After a physical examination, the tendon damage was assessed by ultrasounds examination. The patients were then tested on an isokinetic dynamometer and the peak torque per unit of mass (PTm) developed by the quadriceps and the hamstrings were recorded for various testing modalities. After each test, a visual analog scale (VAS) was used to estimate the pain felt by the patients.

**Results:** No significant correlation was found between the MTm and the demographic variables. The difference in MTm between the healthy and the pathological limbs was significant only in concentric 60°/s, for both the quadriceps and the hamstrings. Lastly, the VAS score showed that the most intense pain was experienced after the eccentric test.

**Conclusions:** There is no specific patient strength profile emerging from the isokinetic test. This stresses the importance for the clinicians to make testing and to apply a personalized treatment to each patient. On the other hand, the isokinetic eccentric testing of the quadriceps could be used to induce a mechanical stress on the tendon for a reliable pain assessment.

#### **P62: VARIATION WITHIN THE NOS2 GENE INFLUENCES RISK OF ACHILLES TENDON PATHOLOGY IN A BRITISH COHORT**

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Achilles tendon pathology (ATP) has a multifactorial aetiology involving both intrinsic and extrinsic risk factors. Non-modifiable intrinsic factors include gender, age and genetics. It has been shown that nitric oxide synthase (NOS) enzymes are elevated in tendinopathy, and NOS is also associated with tendon cell apoptosis. The effects of NOS2 gene variation as a risk factor for ATP are not fully understood. We aimed to ascertain whether the rs2779249 variant that lies -1026 base pairs upstream of the NOS2 gene was associated with the risk of ATP in a British cohort. DNA from 121 Caucasian ATP cases and 129 controls were genotyped using qPCR. We used both chi-squared and ANOVA to assess whether genotype was associated with ATP. We found there was a significant ( $p = 0.009$ ) genotype distribution difference between ATP cases (C/C, 60.3%; C/A, 27.3%; A/A, 12.4%) and controls (C/C, 46.5%; C/A, 45.7%; A/A, 7.8%). Furthermore, we found that the C/A genotype was statistically ( $p = 0.002$ ) overrepresented in the controls compared to the ATP group. In conclusion, the C/A genotype of the NOS2 rs2779249 variant was associated with lower risk of ATP. We found no direct effect of age, weight, or BMI on the risk of ATP in this cohort.

#### **P63: NOVEL MEDIATORS OF CALCIFIC TENDINOPATHY**

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**Introduction:** With advancing age manifold changes in tendons occur, resulting in an increased risk for degeneration, a decline in functionality and an enhanced susceptibility to injury. Our understanding of the underlying mechanisms remains fragmentary, especially for cellular and molecular events leading to calcific tendinopathies. Recently, Toll-like-receptor (Tlr) signalling has been linked to osteogenic differentiation of MSCs isolated from various tissues and it has been reported that calcification of aortic valves – an age-related disease – is dependent on the activation of Tlr3. As tendons and heart valves share regulatory mechanisms during early development, we hypothesized that Tlr signalling also drives age-related tendon calcification.

**Methods:** For in vitro studies tendon-derived cells isolated from young, healthy-aged wildtype, and Tlr3-/-mice were differentiated into the osteogenic lineage and were analysed by RT-qPCR, Western Blot, Alizarin Red-staining, and by Tlr3-specific agonists or antagonists. In vivo studies were performed in a mouse model of Achilles tendon injury comparing wildtype and Tlr3-/-mice.

**Results:** Healthy-aged mouse tendons and tendon-derived cells showed increased expression of Tlr3 and osteogenic marker genes. Specific activation of Tlr3 enhanced matrix mineralization and osteogenic differentiation in vitro in a concentration dependent manner, whereas specific inhibition of Tlr3 prevented calcium deposition in 2D cultures. A tendon needle punch injury model was established to compare ectopic mineralization in wildtype and Tlr3-/-Achilles tendons.

**Conclusion:** Tlr3 signalling is altered during aging in mouse tendons and tendon-derived cells and we propose that ectopic mineralization in tendons is in part Tlr3-mediated.

#### **P64: A SURVEY OF PHYSIOTHERAPY PRACTICE IN THE UK FOR PATIENTS WITH GREATER TROCHANTERIC PAIN SYNDROME**

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##### **Purpose**

Greater Trochanteric Pain syndrome (GTPS) is a debilitating condition causing lateral hip pain. It affects 23.5% of women and 8% of men between 50-75 years old. Sufferers report comparable quality of life and functional performance to patients with end stage Osteoarthritis of the hip. Understanding of GTPS remains limited, particularly with regards to optimal management strategies. Hence, the purpose of this cross-sectional survey was to describe current UK physiotherapy practice as a means of informing the development of a physiotherapy intervention for evaluation in future research.

##### **Methods**

An online survey was developed and distributed via Twitter, the interactive Chartered Society of Physiotherapy website, Musculoskeletal Association of Chartered Physiotherapists and the professional networks of the authors via email. Responses were collected over a four week period, completing April 2018. The data were analysed descriptively.

##### **Results**

A total of 409 surveys were completed, with 382 eligible for use. Nearly all physiotherapists were either somewhat, or very confident diagnosing (97%) and treating (97%) patients with GTPS. The management strategies most frequently used were: education on load management (99%) and self-management strategies (98%). Strengthening exercises (98%) were frequently used and targeted to the hip abductors (94%). Most frequently these exercises were delivered via a home exercise programme (91%) and one-to-one therapy sessions (90%).

##### **Conclusion**

The data from this large survey highlight some consistency with regard to the physiotherapy management of GTPS; with the focus of interventions being patient education on load management and self-management strategies, and strengthening exercises targeting the hip abductors.

#### **P65: WORKLOAD AND PATELLAR TENDINOPATHY IN YOUTH BASKETBALL**

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**Background/Purpose:** Workload (WL) is an important modifiable factor for the prevention of overuse injuries, including patellar tendinopathy (PTP). The purpose of this study was to investigate the association between WL and PTP in youth basketball players.

**Methods:** A nested case-control study including 152 players (aged 13 – 18 years) from 15 youth club basketball teams was conducted within a larger cohort study including school and club basketball players. Players were screened into two groups at the beginning of this study: PTP cases and no PTP (controls) using a validated questionnaire adapted from the Oslo Overuse Injury Questionnaire. Mean differences in measures of WL, including: i) cumulative jump counts measured using a wearable jump device (external WL), ii) basketball sessions completed (external WL), and iii) session rating of perceived exertion (sRPE) in arbitrary units (AU) (internal WL) within one week, were examined between cases and controls using simple linear regression analysis with adjustment for clustering by team, using Bonferroni correction.

**Results:** A total of 144 players (19 PTP cases, 125 controls) met inclusion for final analyses. Point estimates showed that players with PTP had a higher jump count [mean difference (95%CI): 45 jumps (-22 to 112)],

completed more basketball sessions [mean difference (95%CI): 0.9 (-0.7 to 1.9)], and had higher sRPE [mean difference (95%CI): 309 AU (-364 to 981)] than controls, although these findings were not statistically significant.

**Conclusions:** Players with PTP appear to have a higher workload than healthy controls despite the presence of symptoms.

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#### **P66: PATELLAR TENDON INJURY MODEL IN RATS MIMICS THE DEGENERATIVE STAGES OF HUMAN TENDINOPATHY**

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**Introduction:** Human tendinopathy is the most common overuse tendon injury and is commonly characterized by pain and impaired performance. The pathogenesis is poorly understood and it has been variously defined as a degenerative condition or as a failure of the healing process. The purpose of this study is to develop a new experimental animal model of patellar tendinopathy in rats which mimics the human tendinopathy.

**Methods:** The administration of collagenase was performed by ultrasound-guided injection at the level of the proximal and deep portion of the patellar tendon in anesthetized animals (N = 6). The tendon lesion was evaluated 2 weeks after injury by ultrasound analysis and by histological and immunofluorescence studies.

**Results:** Cross-sectional area of the injured tendons was significantly increased by more than 50% in tendon thickness when compared with contralateral controls. Neovascularization was confirmed by doppler ultrasonography in the injured tendons. By means of histology and immunofluorescence analysis, irregularity in the parallel pattern of the collagen fibers, an increased cellularity and clear modifications in collagen deposition were observed in collagenase-induced lesion model. We also detected intratendinous neoangiogenesis and innervation by analyzing the  $\alpha$ -smooth muscle actin and neurofilament protein expression, and a large increase of nucleostemin (+) tendon stem cells were found throughout injured tendon structure.

**Conclusion:** The experimental model of patellar tendinopathy in rats provokes a distortion of the patellar tendon architecture and biological events, which closely mimics the patellar tendinopathy seen in human clinics.

#### **P67: INNERVATION PATTERNS OF THE SUPERFICIAL PERITENDINOUS TISSUE OF THE PATELLAR TENDON IN JUMPER'S KNEE PATIENTS**

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**Introduction:** Surgical treatment of jumper's knee has been focused on the inside of the tendon. New research has shown that the nerves are located outside the dorsal side of the tendon. This study aimed to study the innervation patterns in patients that also have ultrasound (US) and colour Doppler (CD) verified changes on the superficial side of the tendon.

**Methods:** Tissue sections from the superficial peritendinous tissue of the patellar tendon from 7 patients (2 women, 5 men; mean age 27.3 years, range 18-53 years) were analyzed for morphology and innervation patterns. Samples were stained for morphology (hematoxylin, HTX) and immunohistochemically for general nerve marker  $\beta$ -tubulin, sympathetic (tyrosine hydroxylase, TH) and sensory nerve fibers (calcitonin related gene peptide, CRGP).

**Results:** All tissue specimens contained multiple nerve fascicles and sprouting nerve fibers as evidenced by evaluation for HTX and  $\beta$ -tubulin reactions. Often those nerves were found in close vicinity to blood vessels and contained sensory and sympathetic axons.

**Conclusion:** The marked innervation in the superficial peritendinous tissue in patients with jumper's knee may be related to pain especially when the patient also exhibits superficial changes on US+CD. The potential impact of this tissue should be considered when performing and discussing treatments.

#### **P68: EFFECT OF EXERCISE STRATEGY ON STRENGTH AND PROPRIOCEPTION IN VOLLEYBALL PLAYERS WITH INFRASPINATUS MUSCLE ATROPHY**

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Infraspinatus muscle atrophy is common in professional volleyball players, but it is unclear whether commonly observed strength and proprioception deficits can be reversed with training. Fifty-four participants were recruited

into an infraspinatus atrophy group (IAG, n = 18) and a non-atrophy group (NAG, n=18) of elite volleyballers plus a healthy non-athletic control group (CG, n = 18). IAG were trained with a progressive, specific shoulder external rotator strengthening routine for 32 sessions over 8 weeks. Shoulder external rotation peak torque (SERPT) and threshold to detect passive movement (TTDPM) and joint position sense (JPS) were measured before and after the intervention. At baseline, no significant difference was detected in strength or proprioception between the injured and control groups, but the normal athletes were stronger and had better proprioception than either IAG or CG ( $p < 0.001$ ). IAG ( $d = 2.78$ ) and NAG ( $d = 0.442$ ) improved strength significantly after training. IAG improved TTDPM and JPS ( $p < 0.001$ ,  $d = -0.719$  and  $-2.942$ , respectively) but were still worse than NAG ( $p < 0.001$ ). Elite volleyball players with Infraspinatus muscle atrophy have strength and proprioception deficits which can be improved by a specific exercise program to normal but not elite athlete control levels.

**Key-words:** infraspinatus atrophy; proprioception; volleyball; strength training; threshold to detect passive movement; joint position sense; isokinetic dynamometer.

#### **P69: INJECTION OF STEM CELLS INTO INJURED TENDON RESULTS IN LIMITED RETENTION AND DISTRIBUTION OF CELLS**

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**Introduction:** Implantation of mesenchymal stem cells (MSCs) into injured tendon is commonly achieved by injection with a hypodermic needle. However, the distribution and retention of cells, within the tendon has not been investigated. We used the horse as a natural model for human tendon injury to evaluate the efficacy of direct injection as a cell delivery method.

**Methods:** Fluorescent-labeled MSCs suspended in bone marrow supernatant containing India ink were injected directly into the injured tendons of horses (n=4) under ultrasound guidance. Two hours after implantation sections of the injection site were harvested and examined. The distribution of MSCs in ultrasound videos at implantation was compared with the post injection histology.

**Results:** MSCs were observed in the sections predominantly in the endotenon and needle duct and always with the India ink particles. At injection the ultrasound movie showed that MSCs and supernatant spread widely within the injured area via endotenon. The video also showed the injected material flowed to surrounding tissue via the needle tract.

**Discussion:** We demonstrated that MSCs and supernatant, injected with a needle did not spread widely after two hours, to the extent suggested by ultrasound. India ink also showed limited post-injection distribution. The spread after two hours was significantly less than suggested by ultrasound at the time of injection. Tension in the tendon may contribute to outflow of injected materials via needle duct. These findings in a natural animal model of tendon injury have relevance to cell therapy methods for treatment of human tendon injury.

#### **P70: DOES SYSTEMIC INFLAMMATION IMPACT ON TENDON QUALITY?**

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**Introduction** Several known risk factors for acquiring tendinopathies, such as diabetes or obesity, are associated with a systemic low-grade inflammation. We now hypothesize that also systemic inflammation in the context of allergic asthma contributes to the pathogenesis of tendon disease. We therefore test in a mouse model of grass pollen allergy, whether tendon quality is affected by this condition.

**Methods** 60 mice were sensitized with a clinically relevant allergen derived from timothy grass pollen (Phl p 5) and challenged intranasally three times. As a control 60 animals received sham treatment only. Six weeks after the first sensitization, Achilles tendons were histologically analysed.

**Results** Serum levels of INF $\gamma$ , IL-4, IL-5, IL-6, IL-13, IL1 $\beta$ , and TNF $\alpha$  were significantly elevated in the allergic animals. Further, semiquantitative immunohistochemical analysis of Achilles tendon samples showed that the number of cells expressing immune-related markers such as F4/80, Iba-1, CD68, and CD163 were significantly elevated in this group. Moreover, by polarisation microscopy we observed a significant increase in fibre angle dispersion and significantly decreased birefringence intensity, indicating impaired matrix integrity in the tendons of allergic animals.

**Discussion** With this work we show that grass pollen allergy affects Achilles tendons in mice, suggesting that systemic inflammation induced by allergy may be a so far overlooked risk factor for tendon disease.

#### **P71: ULTRASOUND-BASED EVALUATION OF INTRATENDINOUS DEFORMATION IN ACHILLES TENDONS OF PATIENTS WITH MID-PORTION TENDINOPATHY.**

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Tendinopathy, the clinical syndrome of pain and/or swelling in and around a tendon combined with impaired function, is an important sport-related injury. The exact cause and pathogenesis of Achilles tendinopathy remains unknown. The morphological changes a tendon undergoes in overuse injuries are well known and documented through routine use of ultrasound or magnetic resonance imaging in clinical practice. The changes in mechanical behavior in pathological tendons, on the other hand, remain largely unknown. Importantly, understanding the mechanics of tendons in the presence of pathology could offer an insight into the effect of the current treatments and may possibly lead to improvement of our treatment strategies.

The evaluation of the mechanical properties in-vivo is less straightforward than morphological evaluation. The last decades, techniques using ultrasound to evaluate tendon lengthening by tracking of the musculotendinous junction and the insertion of the Achilles tendon, have been used to estimate global tendon stiffness and strain. However, measuring global longitudinal stiffness and strain is only a general estimation, while new research has shown that local deformation patterns might differ greatly from the global level.

The objective of this explorative study (6 patients) was to quantify the intratendinous deformation patterns of pathologic tendons in-vivo by means of high-frequency US based speckle tracking to track the possible influence of tendinopathy on tendon mechanics. We recorded the displacement of the superficial, middle and deep layer of the Achilles tendon of both the painful and non-painful side when performing heel raises standing on unipodal or bipodal.

#### **P72: EXCISION OF THE PLANTARIS TENDON IN PATIENTS WITH CHRONIC MIDPORTION ACHILLES TENDINOPATHY: A SYSTEMATIC REVIEW**

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**Purpose:** Conservative and surgical treatments for chronic midportion Achilles tendinopathy are available and successful. Although, treatments fail in a subgroup of patients, remarkably when pain is medially located suggesting involvement of the plantaris tendon in these patients. This review systematically evaluates the literature on studies in which the plantaris tendon was removed in patients with chronic midportion Achilles tendinopathy and discusses the role of the plantaris tendon in this subgroup.

**Methods:** Two databases (PubMed and Embase) were electronically searched for studies in which the plantaris tendon was removed in patients with chronic midportion Achilles tendinopathy. The primary outcomes of interest were the VISA-A score and the VAS score. Secondary outcome measures were return to sport and level of satisfaction. All studies were assessed on methodological quality with the Coleman Methodology Scale and risk of bias with the Newcastle-Ottawa Scale.

**Results:** Six studies were included. All studies showed an improvement in the primary and secondary outcome measure. However, studies were non-randomized, not controlled and of small sample size, resulting in poor methodological quality and high risk of bias. Results were not pooled in meta-analysis due to heterogeneity.

**Conclusion:** Excision of the plantaris tendon in patients with chronic midportion Achilles tendinopathy results in improvement of function and reduction of pain. The absence of good methodological quality and the presence of bias reflect the necessity of randomized studies in the future to report evidence about this intervention.

#### **P73: THE EFFECTS OF A 10KM RUN ON THE STRUCTURE OF THE ACHILLES TENDON**

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**Introduction:** Recent studies have shown tendons to undergo transient changes in structure due to external loads like running. This is due to the large loads transferred through the Achilles tendon during locomotion. This study is the first to examine changes in Achilles tendon structure as a result of a 10km race in healthy students.

**Methods:** The Achilles tendon of 12 healthy subjects was examined prior to a 10km running race and 48 hours post run using UTC. Subjects were recruited from a university running club. UTC analysis was completed in window size 9 and statistical analysis completed to examine echo-type, mean cross-sectional area (mCSA) and tendon volume of aligned and disorganised fibrillar structure and the whole tendon.

**Results:** There was no difference in echo-type percentage from the pre run to post run, echo-type I 52.5% (9.9) to 52.2% (11.1), echo-type II 35.9% (5.1) to 36.0% (5.3), echo-type III 8.7% (4.9) to 9.0% (5.3) and echo-type IV 2.9%(1.2) to 4.2% (4.5). There was no change in the mCSA and volume of either the aligned or disorganised

fibrillar structure of the tendon ( $p>0.05$ ). There was a significant change in the total volume and mCSA of 49.3mm<sup>3</sup> (76.6) and 2.7mm<sup>2</sup> (3.8) respectively with a p value of 0.047.

**Conclusion :** The results show that whilst there was not change in percentage of the different echo-types there appears to be a change in the tendons size. Further study is needed to determine if this is transient or not.

#### **P74: THE EFFECT OF A PROFESSIONAL GAME OF FOOTBALL ON THE STRUCTURE OF THE ACHILLES TENDON**

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**Introduction:** A game of Australian rules football has been shown to trigger transient changes in the structure of the Achilles tendon as measured by Ultrasound tissue characterisation (UTC). It is unknown whether this same transient change occurs with other sports. This study investigates the effect a game of professional football has on the structure of the Achilles tendon.

**Methods:** The Achilles tendons of a team of professional footballers (n=13) was examined using UTC. Scanning was completed 24hrs pre game and at 48hrs post game. The tendons were analysed using a 20mm zone and analysed in window size 9. Analysis compared echo type percentages, volumes and mean cross-sectional area (mCSA) of the whole tendon and aligned fibrillar structure (AFS) between the two time points.

**Results:** Mean and SD are reported for the baseline and 48hr analysis for all subjects. Echo-type I 52.0%( 10.9) versus 53.8(8.3), Echo-type II 31.6%(4.5) versus 31.9%(3), Echo-type III 11.8(6.5) versus 10.1(4.8) and Echo-type IV 4.5%(2.5) versus 4.1%(2.0), there was no statistical difference between the timepoints. Significant changes were identified in the volume and mCSA of the Aligned fibrillar structure with both increasing from 1239.5mm<sup>3</sup>(262.6) to 1318mm<sup>3</sup>(252.4) and 62.0mm<sup>2</sup>(13.2) to 65.9mm<sup>2</sup>(12.6), p values = 0.038. The Total volume and mCSA area increased from 1497.7mm<sup>3</sup>(362.5) to 1542.8mm<sup>3</sup>(299.7) and 74.9mm<sup>2</sup>(18.1) to 77.1mm<sup>2</sup>(15.0) respectively, both changes were non-significant (p=0.198).

**Conclusions:** A game of professional football did not cause transient changes in tendon structure as measured by percentage of echo-type, however it did change the AFS measured as a volume or mCSA.

#### **P75: ACHILLES TENDON STRUCTURE IN PEOPLE WITH A NEUROLOGICAL DISORDER**

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**Introduction:** Neurological disorders such as Multiple Sclerosis (MS) and Cerebrovascular accidents (CVA) are known to affect the function and structure of the Achilles tendon. Various studies have shown alterations to the Achilles tendon, however due to limitations with imaging methodology it has been impossible to quantify the extent of these changes. This is the first study to investigate Achilles tendon structure using Ultrasound Tissue Characterisation (UTC) in people with a neurological disorder.

**Methods:** A cross sectional study was completed recruiting subjects with either a CVA (n=10) or MS (n=9) and healthy age matched subjects (n=19). Each participant underwent a UTC scan of both Achilles tendons. The UTC image was analysed to determine if there was the presence of pathology and a 10mm section was contoured, around the section with the most disorganisation. If no pathology was observed then an arbitrary section was used 30mm above the calcaneum. The mean cross-sectional area (mCSA) of aligned fibrillar structure (AFS) and disorganized fibrillar structure (DFS) was quantified using UTC analysis software and reported in window size 9.

##### **Results:**

The mCSA of AFS was 74.1 mm<sup>2</sup> (SD 27.5mm<sup>2</sup>) in subjects with a neurological disorder and 67.3mm<sup>2</sup> (16.6mm<sup>2</sup>) in the healthy subjects. The mCSA of DFS was 20.2mm<sup>2</sup> (20.1mm<sup>2</sup>) and 5.9mm<sup>2</sup> (4.9mm<sup>2</sup>) respectively. MCSA of AFS was not significantly different (p=0.154) between the groups, whilst mCSA of DFS was significantly different between the groups (<p=0.001).

**Conclusions:** Neurological disorders appear to be associated with altered Achilles tendon structure, in particular an increase in disorganised fibrillar structure.

#### **P76: CHANGES IN ACHILLES TEMPERATURE AS A RESULT OF A 5KM RUN**

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**Introduction:** We recently published a theory of Aetiology of Achilles tendinopathy involving excess hysteresis within the tendon. No human measurements of Achilles temperature have been reported after locomotive activity. This study examines the thermal change of the Achilles tendon as a consequence of a 5km run in subjects with and without Achilles tendinopathy.

**Methods:** A cross sectional study was completed recruiting healthy runners (n=16) and runners with AT (n=6). The

temperature of the Achilles tendon was examined using a thermal camera, measures were taken immediately pre and post 5km run on a treadmill in all subjects. Subjects were able to run at their preferred speed.

**Results:** Data is reported as mean and (SD). The skin overlying the Achilles tendon increased as a consequence of the 5km run by 3.1(2.4) Celsius this was significant,  $p < 0.0001$ . Group analysis showed a significant difference between the healthy runners and the Achilles tendinopathy group,  $p = 0.015$ . The healthy runners Achilles increased by 3.4(2.6) Celsius and the injured cohort's increased by 1.9(1.3) Celsius.

**Conclusions:** Running 5km is associated with a change in skin temperature overlying the Achilles tendon, there appears to be differences in how healthy and injured tendons respond to this level of exercise. Healthy tendons appear to warm more than injured tendons.

#### **P77: THE STRUCTURE OF THE ACHILLES TENDON OF ENDURANCE RUNNERS AND SPRINTERS**

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**Introduction:** Previous research has shown the difference in Achilles tendon structure as a response of lifelong sports participation. With the recent improvements in imaging quality and the ability to quantify tendon structure using ultrasound tissue characterisation (UTC) it is important to examine this area more. This study examines the Achilles tendon structure of endurance and sprint runners.

**Methods:** This study used UTC to examine the tendon structure of healthy adults who habitually undertake sprint ( $n=12$ ) or endurance based running ( $n=14$ ). Each subject had a routine UTC image completed in a prone position. The whole Achilles tendon was contoured and analysed in window size 9. Analysis involved the comparison of echo-types I-IV between the two groups.

**Results:** Results are reported as mean and (SD) for each of the four echo-types with endurance runners results given first and sprinters second. Echo-type I 58.1%(7.2) versus 52.6%(9.9), Echo-type II 30.7%(6.8) versus 35.9%(5.1), Echo-type III 7.7%(4.2) versus 8.7%(4.9) and Echo-type IV was 3.6%(2.0) versus 2.9%(1.2). The difference in Echo-type II was statistically different  $p=0.04$ , No other echo-type was statistically different.

**Conclusions:** The type of running subjects participate in appears to influence tendon structure with a higher proportion of echo-type II present in subjects who sprint. This may reflect greater tendon adaption or a higher water content as a consequence of the higher loads on the tendon.

#### **P78: THE VALIDITY AND RELIABILITY OF THE FYSIOMETER FOR ASSESSING PLANTARFLEXOR STRENGTH**

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**Introduction:** Plantarflexor weakness is an identified prospective factor for the development of Achilles tendinopathy, various authors have reported relationships between symptoms and weakness of this muscle group. Despite the importance of plantarflexor muscle function to Achilles tendinopathy many studies fail to examine it due to the difficulties associated with accessing appropriate tools like isokinetic dynamometry. This study examines a new tool which is quicker and easier to use to determine if it is valid and reliable.

**Methods:** The study was completed in a university laboratory using 20 healthy university students. A crossover design was used with randomisation of testing order. A test was either completed on the gold standard isokinetic dynamometer and then the fysiometer or vice versa. Re-testing on the fysiometer was completed 2 days later for the reliability component of the study. All testing involved isometric maximal force with the knee at 90 degrees flexion.

**Results:** The mean Peak torque on the isokinetic dynamometer was 141.95Nm (46.64) versus 103.35kg (29.13), The results of the correlation revealed a  $r$  value of  $r = 0.79$  with a 95%CI 0.53-0.79. The test re-test reliability was calculated as an ICC of 0.79.

**Conclusions:** The Fysiometer appears to be able to provide valid and reliable measures of plantarflexor isometric strength. It would appear suitable for both clinical and research work.

#### **P79: THERE IS NO DIFFERENCE IN HIP STRENGTH BETWEEN RUNNERS WITH AND WITHOUT ACHILLES TENDINOPATHY**

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**BACKGROUND:** Achilles Tendinopathy (AT) is a condition that leads to pain and physical impairment. Hip strength has been linked to this pathology and might be associated with the AT development. However, no study has investigated the differences between strength of hip stabilizers in recreational runners with and without AT. The

purpose of this study was to compare the Hip strength in runners with AT and controls, and to investigate the association between hip strength and severity of symptoms. **METHODS:** A cross-sectional study was conducted. Eleven runners diagnosed with AT and 11 healthy controls were assessed in the Federal University of Ceará, Brazil. Isometric strength of the hip abductors, external rotators, and extensors was assessed through Hip Stability Isometric Test (HipSIT) and isometric strength of hip External Rotators (ER) was measured in isolation using a handheld dynamometer. The Victorian Institute for Sports Assessment-Achilles (VISA-A) measured the symptoms severity. The t-test was performed to compare means between groups. Pearson coefficient was used to analyze the correlation between VISA-A and strength measures. **RESULTS:** The mean HipSit values of the Tendinopathy (TG) and Control Group (CG) were  $1.05 \pm 0.3$  and  $0.82 \pm 0.26$  N.m/kg, respectively. In the isolated ER strength, TG e CG showed a mean of  $0.66 \pm 0.18$  and  $0.71 \pm 0.16$  N.m/Kg. No differences ( $p > 0.05$ ) were detected between groups in these variables. Also, there was no correlation ( $p > 0.05$ ) between Strength measures and VISA-A score. **Conclusion:** In runners, Hip strength seems not be associated with Achilles tendinopathy prevalence and clinical severity of symptoms.

#### **P80: ADHERENCE TO ACHILLES TENDINOPATHY GUIDELINES BY BRAZILIAN PHYSIOTHERAPISTS: A CROSS-SECTIONAL STUDY**

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**Background:** Adherence to clinical practice guidelines may accelerate recovery and reduce costs associated with Achilles Tendinopathy (AT). The purpose of this study was to investigate whether Brazilian physiotherapists use the best available evidence in clinical decision-making for AT. **Methods:** A cross-sectional study was conducted between January and April of 2018. The sample consisted of physiotherapists from two national physiotherapy associations (sports and orthopedics). The data were collected via an electronic questionnaire with questions about clinical experience, attitudes/beliefs, and knowledge about AT. The participants answered two clinical cases about AT to evaluate their decisions and adherence to guidelines for AT. Each clinical case had 20 options, composed of mandatory, not mandatory and invalid answers. It was considered full adherence to guidelines if at least two mandatory responses were correctly chosen and no adherence in case of less than two. **Results:** A total of 150 physiotherapists were invited and 107 participated in the study. The mean clinical experience time was  $11.5 \pm 6.9$  years; the number of patients treated per month was  $4.4 \pm 4.2$ . The physiotherapists answered an average of 4 (out of 7) questions correctly about AT. 69.2% of the physiotherapists believes that Diabetes may increases the risk of the AT. Full adherence to guidelines was low for both cases (rates ranging from 5 to 24%). There was no relation between adherence, level of knowledge and academic degree. **Conclusion:** Brazilian physiotherapists are not using the best available evidence in their clinical decision-making for patients with AT.

#### **P81: GREATER TROCHANTERIC PAIN SYNDROME TREATED WITH A STRUCTURED PHYSIOTHERAPY PROGRAM AND EXTRACORPOREAL SHOCKWAVE THERAPY**

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##### **Aim/Introduction:**

Lateral hip pain is a common musculoskeletal complaint, and has been traditionally diagnosed as Trochanteric Bursitis. Recent evidence suggests that lateral hip pain is more commonly associated with gluteal tendinopathy, and that the bursa is seldom involved. Greater Trochanteric Pain Syndrome (GTPS) is a more appropriate term for this diagnosis. The purpose of this study was to review the outcomes of patients with GTPS to a standardised treatment program that targets the gluteal tendon and muscle unit.

##### **Method:**

Thirty-eight patients diagnosed with GTPS were included in the review. Baseline assessment involved a routine examination and completion of the Victorian Institute of Sport Assessment – Gluteal (VISA-G) questionnaire. Patients completed a standardised home exercise program. Extracorporeal Shockwave Therapy (ESWT) was used as an adjunct for patients with a response of less than 15 points on the VISA-G upon review at 6 and 12 weeks.

##### **Results:**

The treatment program was completed by thirty-eight patients. Thirty (79%) of the patients received ESWT as part of their treatment. The mean change in VISA-G was 13 points at 6 weeks, and 23 points at 12 weeks.

##### **Conclusion:**

A structured program of exercise, advice and ESWT has been shown to bring about improvements in the



management of GTPS. The results of this review suggest a structured physiotherapy approach should be considered as a treatment option for those suffering from GTPS. For those who do not respond to exercise alone, ESWT should be considered as an adjunct to a loading program.

#### **P82: PLANTAR FASCIITIS TREATED WITH LOADING, ADVICE AND EXTRACORPOREAL SHOCKWAVE THERAPY**

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**Introduction:** Plantar fasciitis (PF) is the most commonly reported cause of plantar heel pain. It is characterized by pain of the calcaneal origin of the plantar fascia and altered function. Results from a recent randomised controlled trial demonstrated favourable outcomes from a loading program in the treatment of this condition. Extracorporeal Shockwave Therapy (ESWT) has been shown to benefit those who suffer from PF. The purpose of this study was to review the outcomes of patients with PF to a standardised treatment program of advice, loading exercises and ESWT.

**Methods:** Twenty patients diagnosed with plantar fasciitis were included in this review. Baseline assessment included a routine examination and completion of the Functional Foot Index (FFI) questionnaire. Patients were instructed to complete a standardised home exercise program every other day. Patients received three sessions of ESWT as an adjunct to treatment. Patients were reviewed at 4, 8 and 12 weeks.

**Results:** The treatment program was completed by 20 patients. All patients received ESWT and completed the exercise program. The mean FFI score at baseline was 57%. The mean FFI score was 37% at 4 weeks, 30% at 8 weeks and 20% at 12 weeks.

**Conclusions:** The aforementioned program of exercise, advice and ESWT has been shown to bring about improvements in the management of PF. The results suggest a structured program of exercise and advice, alongside ESWT is an appropriate treatment option for those suffering from PF.

#### **P83: ACHILLES TENDINOPATHY, IT MIGHT BE GOUT SO RULE IT OUT. A CASE REPORT**

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**Introduction:** Gout is a crystal arthropathy. The most common area affected is the great toe. Gout can affect tendons. The purpose of this report is to highlight the importance of history taking, to ensure the appropriate treatment is recommended.

**Methods:** A 27-year old male Gaelic football player presented with a three-year history of Achilles tendinopathy. The patient had attended multiple clinicians and failed to respond to loading programs, shockwave therapy, LASER and high-volume injection. The patient was unable to participate in any sporting activities due to his Achilles pain. Tendinopathic changes were confirmed on ultrasound assessment. Baseline Victorian Institute of Sports Assessment – Achilles (VISA-A) was 30 points.

During clinical examination, the patient reported he was diagnosed with gout in his early 20's. The patient was not on any medication for Gout. The patient had not revealed this to previous clinicians he had seen, as he was unaware Gout could cause tendon pain. The patient was referred to rheumatology, an elevated urate level was confirmed and urate lowering medication was prescribed.

**Results:** Following 6 weeks of urate lowering medication, his VISA-A score was 89 points. He returned to sport and commenced a loading program. His VISA-A was 97 points at 24 weeks and he was participating fully in competitive sports

**Conclusions:** Gout can present as Achilles tendinopathy. Patients may not relate their Achilles pain to gout. This case highlights the importance of obtaining a thorough history during examination of patients with tendinopathy, as inflammatory pathology may cause tendinopathy.

#### **P84: AN INVESTIGATION INTO THE EPIDEMIOLOGY OF ACHILLES TENDINOPATHY AMONG ELITE NATIONAL CRICKETERS**

S. Singh<sup>1</sup>, A. Rodrigues<sup>1</sup>, S. McCaig<sup>2</sup>, B.D. Kumar<sup>1</sup>

<sup>1</sup>Institute of Sport, Exercise and Health, LONDON, United Kingdom

<sup>2</sup>English Cricket Board, LOUGHBOROUGH, United Kingdom

**Background:** Achilles tendinopathy affects Cricketers, but there is a paucity of available literature.

**Aim:** This cross-sectional study investigated the epidemiology of Achilles tendinopathy (AT) among elite English national team cricketers and potential associated factors.

**Method:** Clinical, VISA-A, biomechanical, and imaging data was collated using Ultrasound Tissue Characterisation

(UTC) of the Achilles tendons of elite male cricketers (n=72, mean age=20.6, SD +/- 3.9) during pre-season profiling.

**Results:** Only one player was symptomatic of AT at the time of assessment. A further three players had a previous diagnosis of AT. All of these showed tendon structural abnormalities on imaging. There was no association between UTC tendon structure (ETI+II) and age ( $R = 0.16$ ,  $p=0.17$ ), weight ( $R = 0.10$ ,  $p=0.5$ ) and VISA-A ( $R = 0.199$ ,  $p=0.15$ ).

Among asymptomatic tendons, UTC imaging revealed a higher prevalence of structural abnormalities within the Achilles mid-portion (N= 10/83) compared with the insertion (N= 4/98). There was no significant difference between legs.

Among asymptomatic fast bowlers, greater dorsiflexion angle at ground contact on the bowling crease correlated with a lower UTC structure ETI+II of the Achilles insertion zone ( $R=0.35$ ,  $p=0.03$ )

**Conclusion:** This is the first study describing the prevalence of AT among elite national squad cricketers, revealing a low prevalence of symptomatic AT, but considerable prevalence of currently asymptomatic Achilles tendon abnormalities that could precede morbidity, and thus may benefit from monitoring. Front foot dorsiflexion angle at ground contact in fast bowlers may warrant further investigation given the association with poorer Achilles insertion structural integrity on UTC.

#### **P85: ARE JUMP LANDING PATTERNS ASSOCIATED WITH PATELLAR TENDINOPATHY IN COMPETITIVE ATHLETES? - A SYSTEMATIC REVIEW**

A Haque, A Tayfur, JI Salles, D Morrissey

Queen Mary University of London, LONDON, United Kingdom

**Introduction:** Patellar tendinopathy is common, and debilitating for jumping athletes. We aimed to determine whether competitive athletes with PT (AwPT) display consistent biomechanical features associated, to help inform coaches/clinicians managing and trying to prevent such injuries.

**Methods:** 4 databases were searched from inception-02/2018 for observational studies or trials evaluating landing biomechanics in AwPT. Modified Downs and Black or PEDro scales were used for quality assessment, evidence levels established using van Tulder's criteria, and bias risk evaluated using Cochrane criteria.

**Results:** 17 studies (12 high-quality): two prospective cohort, twelve cross-sectional, two controlled laboratory, and a randomised controlled trial (RCT) were identified. Moderate evidence indicates AwPT have landing techniques that decrease patellar tendon loads. Limited evidence suggests chronic high peak vertical ground reaction forces is a risk factor. Moderate evidence suggests leg stiffness is a causal risk factor with complementary strong associative evidence. Limited evidence indicates an inverse association between trunk flexion and tendon loads. Moderate evidence suggests increasing knee-joint ROM and extensor flexibility, and improving dorsiflexion-plantarflexion ranges at initial-contact, potentially reduces landing stiffness; consequently tendon loads.

**Conclusions:** Landing biomechanics are associated with PT but only tentative guidance to clinicians and coaches is currently warranted. Further prospective study could establish multi-factorial causality while RCTs could investigate the effects of movement strategies on risk reduction. Parallel exploration of impact on sport-specific performance would be required.

# General Information

## Venue

The symposium will be held at the University Medical Center Groningen.

Address: Hanzeplein 1, 9713 GZ Groningen, The Netherlands.

*Note: Saturday, September 29, entrance of the UMCG is only possible through the Main Entrance at the Hanzeplein.*

## Symposium Desk

FORTEINPATIO ('FOUNTAIN PATIO'), GROUND FLOOR.

The symposium desk is open from Thursday 08.00 hr. till Saturday 14.00 hr.

## Main Lecture Hall

BLAUWE ZAAL, GROUND FLOOR.

The Main Lecture Hall is called Blauwe zaal ('Blue room'). All keynote lectures, free communications (oral presentations) and poster pitches are scheduled in this room.

## Upload Desk - Powerpoint

KEYNOTE SPEAKERS, PRESENTERS OF FREE COMMUNICATIONS AND POSTER PITCHES

On September 27, when arriving at the UMCG, please take care to deliver an usb-stick, with the ppt-slides of the presentation, as early as possible to one of the technicians at the upload desk, to make sure that your presentation will run properly. The upload desk will be open at 08.00 hr.

Powerpoint files/presentations must be delivered to one of those responsible assistants personally and at least 2 hours prior to the presentation. The upload desk will be situated next to the registration desk. Please check any video prior to the presentation on each new medium that you will use, transfer and re-direct video clips to the final location on the medium. The assistant will take care of transferring your presentation onto the projection computer in the 'Blauwe zaal'/'Blue Room'.

## Posters

ENGELSE PATIO, GROUND FLOOR.

All posters should be mounted on Thursday between 08.00–09.00 hr. Removing the posters is possible on Saturday after 12.30 hr. by the participant. The location of the poster area is the 'Engels patio', next to the Fountain Patio. Since the poster area is nearby the Fountain Patio it is possible to walk around during coffee, tea and lunch breaks as well. Poster size: 100 cm width en 120 cm high. See the program for the time slots of the poster sessions.

## Exhibition / sponsors

FOUNTAIN PATIO, GROUND FLOOR.

The sponsor exhibition is in the Fountain patio, the area where also the coffee, tea and lunch breaks are. Opening between Thursday 08.00 hr and Saturday 14.00 hr. The exhibition area is set up according to the map with designated sites for each of the companies.

## WIFI

There is free wifi in the University Medical Center Groningen.

Network: UMCG-Guest.

## Badge

Please wear your badge at all times. The symposium venue is open to the public, badge identification will be used during scientific sessions, breaks and social events.

### **Certificate**

On request participants will receive a certificate of attendance at the end of the Symposium.

### **Special Issue**

A selection of abstracts will be published in a special issue of the British Journal of Sports Medicine. The Scientific Committee will select these contributions during the symposium.

### **Continuing Medical Education**

Continuing Medical Education credits have been received from the:

- VSG (Dutch Society for Sports Physicians) with 17 points:
  - o *Thursday 5 points.*
  - o *Friday 6 points.*
  - o *Saturday 6 points.*
- KNGF (Dutch Society for Physiotherapists) with 15 points for sports physiotherapists.
  - o *Accreditation number 26841.*
- 'Keurmerk' Physiotherapy' with 14 points:
  - o *Thursday 6 points.*
  - o *Friday 5 points.*
  - o *Saturday 3 points.*

### **Welcome Reception: Thursday, September 27 - from 18.00 – 19.00 hours**

FOUNTAIN PATIO, GROUND FLOOR.

All participants are invited to join the Welcome Reception on Thursday from 18.00 - 19.00 hr. in the UMCG, Fountain Patio. The reception is offered to all participants on behalf of the University of Groningen, the Municipality of Groningen and the Province of Groningen.

### **'Tendinoholic' Lustrum Buffet and Party: Friday, September 28 - from 18.30 – 00.00 hours**

RESTAURANT 'HET HEERENHUIS', SPILSLUIZEN 9, GRONINGEN

On Friday evening the lustrum buffet & party will be served at Restaurant 'Het Heerenhuis'. The restaurant is located beside of the canal nearby the city center at about 10 minutes walking distance from the UMCG. See the map of the city center. Participation costs (€ 55,- pro person) for the buffet/party are not included in the symposium fee. Tickets can be bought until September 24, 2018. There are no tickets available during the Symposium.

### **Language**

The Symposium language will be English. Dutch is the predominant language in the Netherlands but English is very popular and is spoken almost everywhere.

### **Insurance**

The meeting organizer cannot accept any liability for personal injuries, loss or damage to properties belonging to participants, either during or as a result of the meeting. Participants are advised to take out their own personal travel insurance.

### **Currency and Banks**

The currency is Euro (€). Other currencies can be changed at banks and railway station. Banking times are 09.00-17.00 hr. every day except Saturday and Sunday.

### **Shopping**

Most shops and department stores are open from 09.00-18.00 hr. from Tuesday to Friday, Monday from 13.00-18.00 hr. and Saturday from 09.00-17.00 hr. Sunday a few shops are open from 12.00 – 17.00 hr. Major credit cards are widely accepted.

**Weather**

The climate in the Netherlands is a sea-climate with temperatures between 14-16°C in September. Please note that there is always a chance of showers, due to variable weather patterns.

**Time**

Summertime in The Netherlands is equal to Central European Time (CET), one hour ahead on Greenwich Mean Time (GMT), and six hours ahead of U.S. Eastern Time.

**Power**

Electricity sockets take two pin round plugs. The electrical current is 220 volts.

**Travel to and in Groningen**

Groningen is situated in the north of the Netherlands and is the hub of the Western Netherlands / Northern Germany distribution route, along which it offers excellent varied transport facilities, by water, land and air.

*By air*

Amsterdam International Airport Schiphol (<https://www.schiphol.nl/en/>) is the Main Airport of The Netherlands and the 4th airport of Europe, after London, Paris and Frankfurt, and provides connections to all parts of the world.

The best way to travel from Airport Schiphol to Groningen is by train ('NS' is the Railway Company). Groningen has a direct train connection (2 hours travel) with the Airport at Schiphol. The NS-train station is located at Schiphol Airport. For all information about travelling by train, please visit the website of the NS (<https://www.ns.nl/en>).

Groningen itself has a smaller airport ([Groningen Airport Eelde](#)) with international connections to London and Copenhagen amongst others. Furthermore, within two hours one can also go from Groningen city center to [Bremen Airport](#), Germany (i.e. KLM, Lufthansa, Air France, Ryanair).

*By train*

Train connections link the city with Schiphol International Airport every 30 minutes. Travel time by train is approximately 2 hours. The Central Station in Groningen is at 20 minutes walking distance from the UMCG. Tickets can be bought in the hall of the railway station at Schiphol Airport. There are two transport classes. More information, see: <http://www.ns.nl/en/travellers/arrange-and-buy>.

*Busses in Groningen*

Arriving at the Central Station in Groningen, several busses will take you to the city center. Some busses will take you directly to the University Medical Center Groningen, see [www.9292.nl/en](http://www.9292.nl/en).

Both the city center (5 min) and the University Medical Center (10 min by bus) are at walking distance from the Central Station. If you are not travelling a lot by bus just buy a single ticket in the bus (just ask the bus driver).

*By car*

Parking facilities are available at the UMCG in Parking garage Noord (paid parking), see [UMCG\\_parking](#) or nearby the UMCG, see [Parkeergarage Boterdiep](#).

**Excursions**

No group arrangements have been organized. Information about individual possibilities to visit Groningen town centre by foot or bike, the canals by boat, musea (etc.) visit the website of the Tourist Information Bureau, <https://toerisme.groningen.nl/en>.

## Wenckebach Instituut

For health care professionals



umcg

The Wenckebach Instituut is a department of the University Medical Center Groningen.



### Route by car

For visitors to congresses or other events the University Medical Center Groningen (UMCG) has a car parking at the north end of the terrain. To get there follow from the Groningen Ring the signs 'UMCG Noord'.

### Public transport

The UMCG is easily reached by public transport. Several bus lines departing from the Central Railway Station drive in about 10 minutes to the UMCG. Some buses stop at the head entrance of the hospital, others at the side and at the north end. You can also use the 'park and ride' city bus.

Because the bus schedules vary often, we direct you for up to date information to the sites for public transport ([www.929200v.nl](http://www.929200v.nl) and [www.citybus.nl](http://www.citybus.nl)/English). Regrettably, the 929200v.nl site is in Dutch. However, its homepage offers the possibility to make an inquiry that probably is understandable, even if you do not speak Dutch.

Wenckebach Instituut UMCG

Hanzeplein 1 Postbus 30.001

9700 RB Groningen

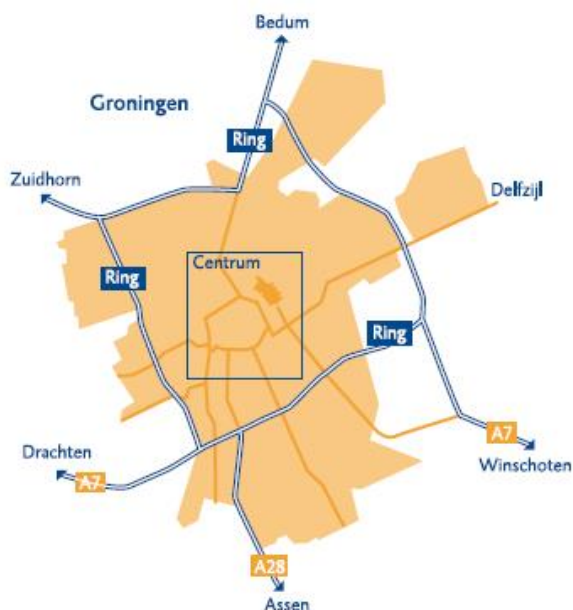
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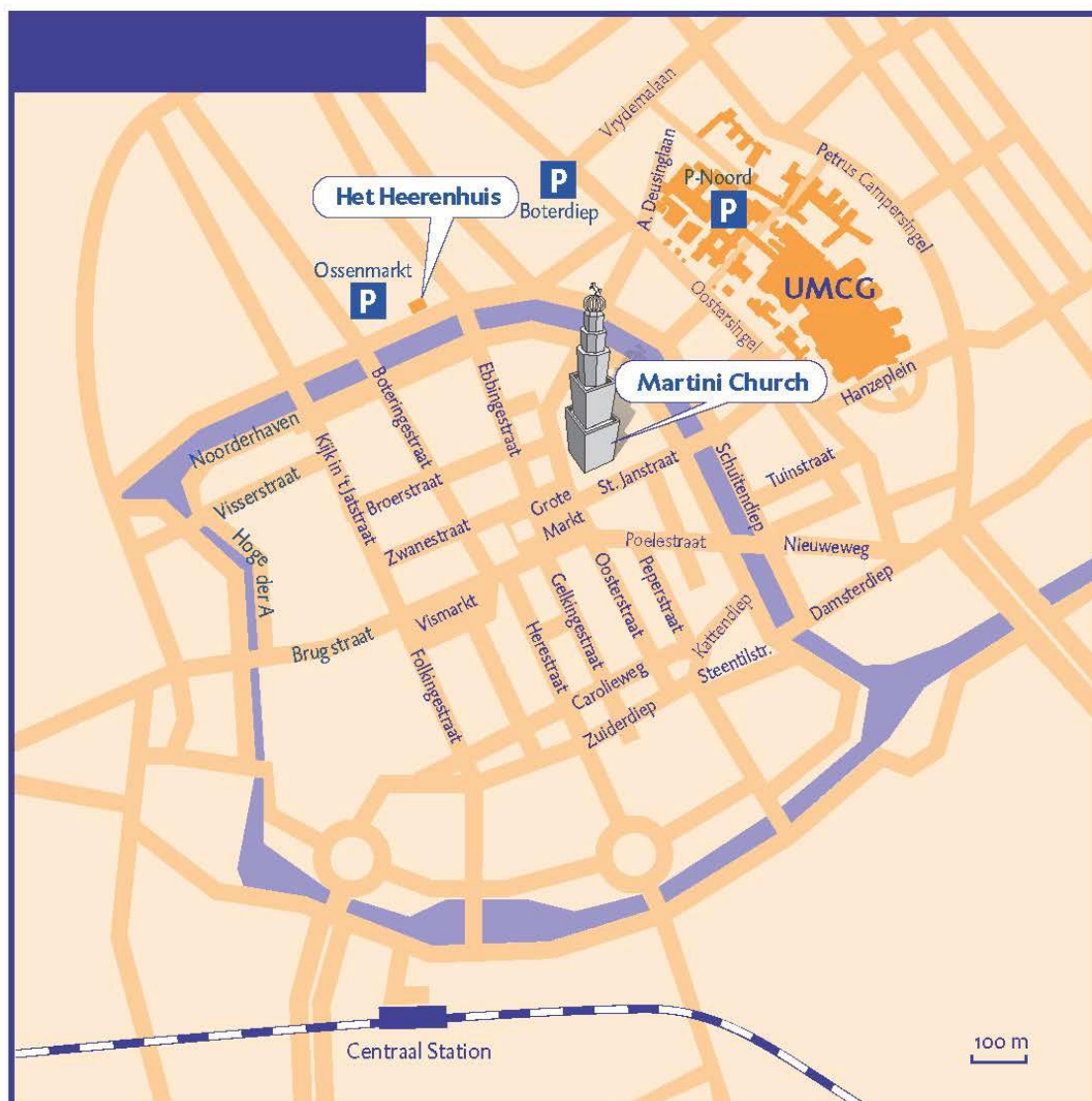
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[www.wenckebachinstituut.nl](http://www.wenckebachinstituut.nl)



**Note:**  
Follow the signs to UMCG-Noord and not to the UMCG main entrance.

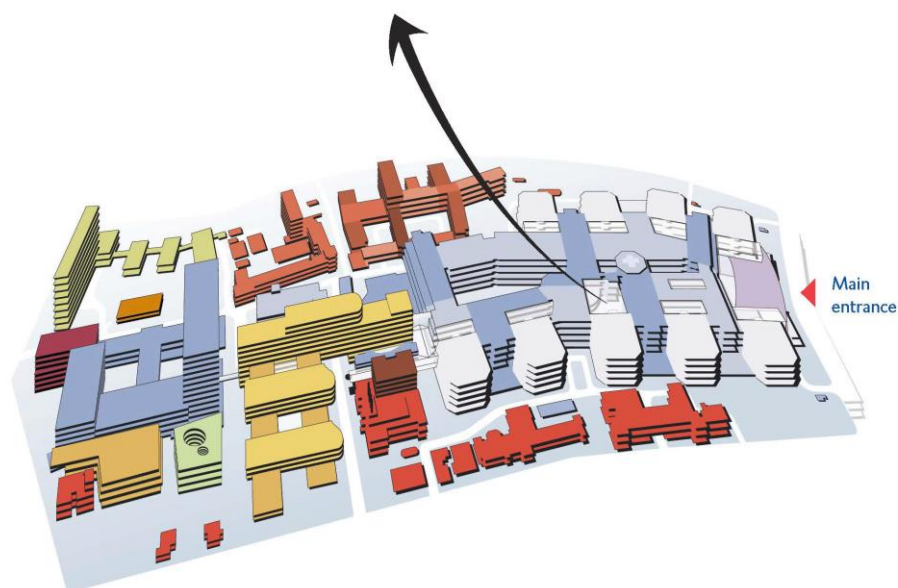
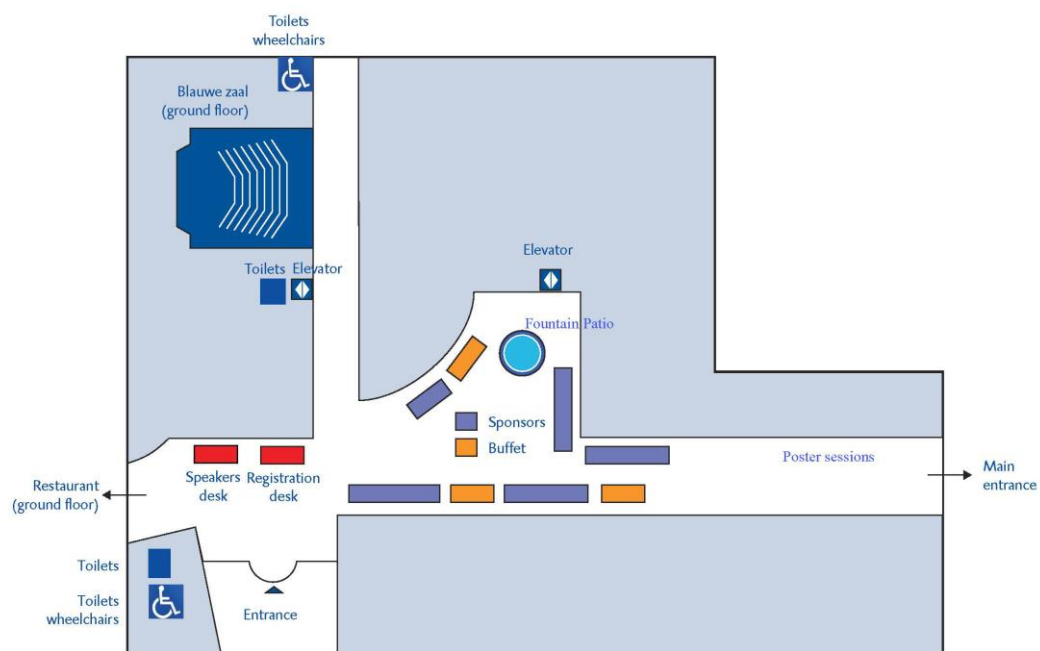
## City map





## Venue / Exhibition Map (Fonteinpatio)

### Floorplan UMCG & 'Blauwe Zaal'





## Sponsors

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### Main sponsor



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