Amsterdam Movement Sciences

Annual Report 2021

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A Bird's Eye view

Director
Dr Richard Jaspers

Director
Professor Mario Maas

Following the first year of the Covid19 pandemic, 2021 was another year with lockdowns and curfews which limited our private and professional lives. However, the vaccinations that became available allowed us some of freedom of movement, but still movements of researchers to and within the Amsterdam Movement Sciences laboratories were restricted. Despite of because of the limitation in travelling and meeting in person, AMS researchers exchanged their discoveries in the many online meetings, started new collaborations and with a resilient attitude new opportunities emerged. Our annual meeting took place with avatars in an online, digital conference environment allowing personal interactions with a taste of real conference.

Many PhD student graduated in online thesis defences and our scientific output was undiminished. The first papers on the effects of Covid19 on our neuro-musculoskeletal system were published in 2021.

In line with our strategic goals to further enhance our impact on emerging themes in movement sciences, two centres of expertise, the Amsterdam Bone Center and Voeding and Bewegen Nu were founded and both had their kick-off meetings in 2021. These centres will foster multidisciplinary collaboration and knowledge dissemination and creation of impact.

Other initiatives to increase societal impact were the successful start of public-private partnerships on the use of augmented-reality glasses to support goal-directed movement in patients with Parkinson's disease and on the treatment of osteoarthritis with an injectable elastic implant. In addition, initiatives in business development to commercialize a new method to prevent unnecessary surgeries in knee replacement surgery were successful with the initiation of the start-up company OrthoKey BV. You can read about these successes in this report showing that 2021 was as year in which we had some

significant breakthroughs in the valorisation of our translational research programmes within Amsterdam Movement Sciences.

Despite the intensified focus on valorisation, the interdisciplinary translational approach to tackle key challenges in the field of movement sciences requires unabatedly fundamental research. This report highlights some of the interesting fundamental research topics addressed in AMS.

Looking back on a year with many challenges and limitations, AMS has been, despite the pandemic, strongly on the move by making valuable achievements contributing to its mission to advance physical and mental performance in both health and disease. We invite you to scroll through this annual report to see some of the accomplishments and meet some of our truly extraordinary members.

Research Programs

Amsterdam Movement Sciences Research Institute

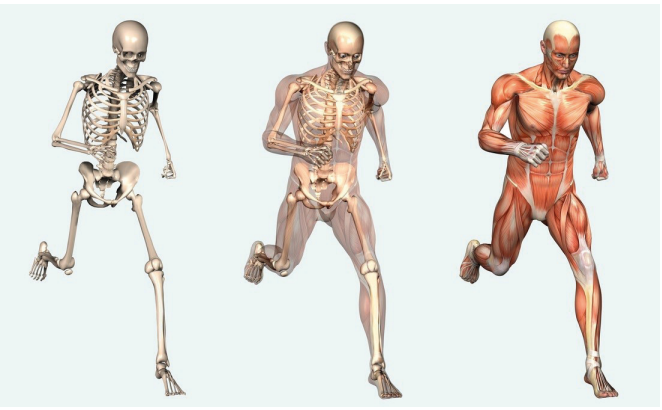
AMS aims to continue being a world-leading research institute on the movement theme. To achieve this, the institute covers the full range of research, from fundamental to translational and applied and vice versa. The institute members publish excellent research and innovative results.

The five current research programs each have their program boards. Some of the programs are in addition supporting knowledge centers with the distinct task of being the linking pins between theory and practice, ensuring that the research results are quickly translated to the patient group or societal target group that can benefit from the results, but also the other way around: that research questions from clinical practice quickly reach the researchers. Within the current structure, there are four applied programs and topics, and one program on basic science underpinning the other four research programs. The research programs have been organized with the aim to enhance the interdisciplinary collaboration between researches from various institute partners and show the research in the translational chain.

Sports

Director: **professor Evert Verhagen**, Amsterdam UMC, location AMC, and deputy-director **professor Geert Savelsbergh**, Faculty of Behavioural and Movement Sciences, VU Amsterdam.

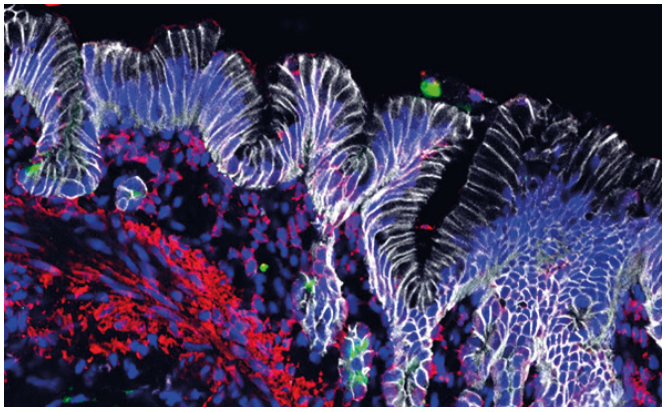
Sufficient physical activity, through sports participation is necessary to reduce the burden of non-communicable diseases and to maintain economic viability, and as such is a fundament for public health. In addition, optimization of performance is key for recreational and elite sports, as well as talent development. The research program deals with a variety of research questions, starting at a fundamental level, through to the optimization of performance, development of interdisciplinary clinical treatment and training guidelines, and to the short and long term behavioural and objective effects of interventions.



Musculoskeletal Health

Director: **professor Raymond Ostelo**, Faculty of Science, VU Amsterdam, and deputy-director **dr Idsart Kingma**, Faculty of Behavioural and Movement Sciences, VU Amsterdam.

The research in this program addresses the various mechanisms underlying the development of musculoskeletal disorders, the development of methods to accurately diagnose and track the progression of the disorders, diagnosis and prognosis of declines in physical performance, and finally the efficacy, (cost-)effectiveness of existing and novel interventions.



Tissue Function & Regeneration

Director: **dr Nathalie Bravenboer**, Amsterdam UMC, location Vumc, and deputy-director **dr Marco Helder**, both Amsterdam UMC, location VUmc.

The aim is to develop and combine (new) techniques to investigate musculoskeletal and skin tissue regeneration at different biological length scales, either isolated or integrated in a two-dimensional (2D) or 3D environment. The members of the program encompass a wide range of researchers, from clinicians to physiotherapists, basic scientists, and private partners.

Ageing & Vitality

Director: **Professor Mirjam Pijnappels**, Faculty of Behavioural and Movement Sciences, VU and deputy-director **dr Carel Meskers**, Amsterdam UMC, location VUmc.

This research program centers on how physiological and pathological ageing is accompanied by a decline on structural, functional and activity levels. Muscle mass, strength and power, bone density, joint flexibility, physical endurance, cardiovascular and respiratory function, sensory acuity, as well as balance performance deteriorate with ageing and age-related diseases. The program aims to unravel the mechanisms of ageing and pathology on mobility and physical functioning, to obtain insight into mechanistic, predictive and limiting factors for mobility and possibly into targets for intervention.

Rehabilitation & Development

Director: **Dr Sicco Bus**, Amsterdam UMC, location AMC, and deputy-director **dr Erwin van Wegen**, Amsterdam UMC, location VUmc
.

This research program includes all translational research addressing optimization of mobility and physical performance of disabling disorders affecting the locomotor functions and brain, for both children and adults. These are the typical rehabilitation target populations, including intensive care unit and diabetic foot disease populations. The research addresses the biological mechanisms underlying declines in physical performance and the effect of interventions preventing/reducing these declines; diagnosis and prediction of declines in physical performance and the underlying impairments and finally the efficacy and (cost-) effectiveness of interventions to prevent/reduce declines in physical performance.

AMS Management Team in 2021 (MT)

The MT was made up of the two AMS directors, the research program directors, an ECR and a PhD representative.

- **Richard Jaspers** (director AMS), Amsterdam UMC, location AMC,
- **Professor Mario Maas** (director AMS), Amsterdam UMC, location AMC,
- **Professor Evert Verhagen**, Amsterdam UMC, location VUmc,
- **Professor Raymond Ostelo**, Amsterdam UMC, location VUmc / VU Amsterdam,
- **Dr Nathalie Bravenboer**, Amsterdam UMC, location VUmc,
- **Professor Mirjam Pijnappels**, VU Amsterdam,
- **Dr Sicco Bus**, Amsterdam UMC, location AMC,
- **Dr Erwin van Wegen**, Amsterdam UMC, location VUmc,
- **Dr Lynn Bar-On**, Amsterdam UMC, location VUmc, / **dr Eric Voorn**, Amsterdam UMC, location AMC,
- **Wouter Schallig** and later **Tim Veneman**, Amsterdam UMC, location AMC.

AMS Office

In support of the directors and the MT, there is a small office, including a communications and social media expert, that ensures the smooth running of the day-to-day activities of the research institute.

New Centers of Expertise

Amsterdam Bone Center

Jan Maerten Smit,
Amsterdam UMC

Marelise Eekhoff,
Amsterdam UMC

Cooperation and knowledge sharing pays off

In November 2021, the Amsterdam Bone Center (ABC) was launched. ABC brings together experts from different medical disciplines to jointly research bone disorders and improve the treatment of patients. Amsterdam Movement Sciences participates by providing financial support. Jan Maerten Smit, reconstructive and microsurgeon, and Marelise Eekhoff, principal investigator Internal Medicine at Amsterdam UMC, explain the background of ABC.

In order to better understand the causes of bone diseases and how to treat them effectively, it is urgent that different medical disciplines work together. In the United States, it has long been customary for these disciplines to work together structurally and to cooperate. This delivers demonstrable added value. In the Netherlands, there is cooperation, but it is mainly on an incidental basis. The Amsterdam Bone Centre aims to make a difference.

From fragmentation to total package

Marelise: 'The Netherlands is a small country, where healthcare is quite fragmented. It is about the members, if they find each other, write joint applications, if they think more about who they can involve, they strengthen their position'. Jan Maerten: 'We are not here to compete with each other. The loner in research has no future. Look at America, where the research schools are big because they offer a total package of research and treatments. We exist by the grace of the usefulness that our members see in this cooperation; we hear a lot of enthusiasm. We warmly invite people to attend our meetings and to work with us!'

'We can certainly play a role in this', continues Marelise. 'Laboratories are desperate for tissue and clinical questions. And clinicians need to think along scientifically. The combination is essential. ABC plays an important role as facilitator.'

Amsterdam Bone Center

Successful approach to rare disease FOP

Marelise Eekhoff gives an example: the rare disease Fibrodysplasia Ossificans Progressiva (FOP). FOP is rare, which is one of the reasons why little is known about it. Within the Amsterdam Bone Center, medical researchers from different fields joined forces. With success: they developed a treatment method that appears to be effective. Blood analysis and very small skin biopsies and research on teeth (when it comes available) is being used to assess the activity of the disease. Alternative ways are being taken to obtain inside in the aetiology and to try to predict the effect of a potential medicine before administration. New potential medicines are tested which are presumed to stop or slow down progression of the disease.

In a similar way, ABC strives to discover new targets for treatment for bone disorders. Jan Maerten Smit: 'This is just the beginning. We hope that the treatment of other diseases will also developed in a similar way.

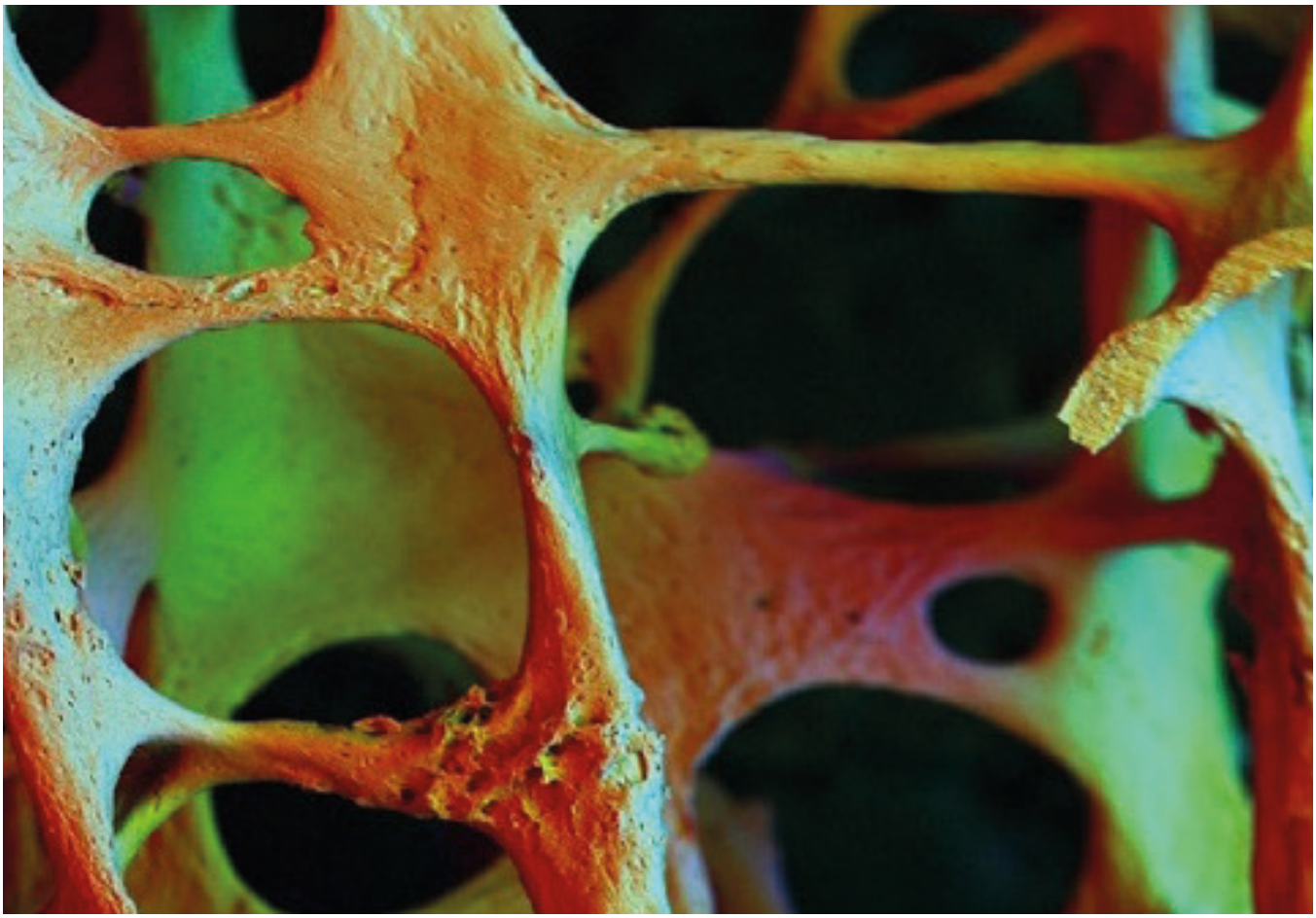
We have a number of pillars within ABC: the rare bone diseases, the metabolic bone diseases, the fracture-related infections and tissue engineering.

Weekly and monthly meetings

Smit explains the working method of ABC: 'Once a week, there is a meeting between radiology, infectious diseases, orthopedics, rehabilitation who examine together tertiary referrals for the treatment of (infected) complicatesd bone fractures and make clinical treatment plans. Every month we organize scientific meetings where specialists from various disciplines discuss current research issues, which is very enriching. This forms a good basis for devising joint projects. Amsterdam UMC is unique in this respect: we have a pre-clinical laboratory for every cell line; there is a great deal in house; I don't know of any other center where it is housed like this. The combination of clinical and pre-clinical research is unique, and then ACTA (the partnership of the faculties of dentistry of UvA and VU) comes along

Succesful Kick off meeting Amsterdam Bone Center

The symposium was opened by Jan Maerten Smit and Marelise Eekhoff, who presented the fascinating history of the ABC. Hanna Willems held a passionate interview with prof. dr. Hans Romijn, Chairman of the Board of Directors about collaboration, diversity and stepping outside the comfort zone, assisted by Jari Dahmen. Marco Helder and Nathalie Bravenboer led the discussion on the possibilities of completely replacing animal research in the future. AMS Director, Richard Jaspers gave insight into the unique relationship between ABC and AMS.



and makes it extra special. The question we ask our speakers is: what kind of research are you doing and where could you use some help, and: what can your contribute to ABC? That is the first step we have taken. If you are creative enough, you can realize plenty of projects on that'.

'We are just at the beginning', says Marelise. 'For the future, we aim for even more cross-fertilisation, that people benefit more from the cooperation and are able to bring in more studies. In the coming years, we expect to expand our work nationally and internationally'.

Hinke Kruizenga lecturer Dietetics, Amsterdam UMC

Peter Weijs, professor Internal Medicine, Amsterdam UMC

Voeding & Beweging NU: connecting science and application

Good nutrition and exercise are both crucial in preventing disease and in recovery. Yet in the past, both topics were not always well connected. Moreover, scientific insights do not always reach the people they concern in an applicable form. This must and can be improved, decided Amsterdam Movement Sciences, the Amsterdam University of Applied Sciences and the Amsterdam UMC. In 2021, they joined forces and Voeding & Beweging NU was born. Dietician-researcher Hinke Kruizenga of Amsterdam UMC and Professor Nutrition and Exercise Peter Weijs of Amsterdam UMC and the Amsterdam University of Applied Sciences are enthusiastic.

Nutrition and exercise have synergy

'Nutrition and exercise have synergy and are both crucial for the prevention of illness and for recovery. We have known this for a long time. That's why we pay a lot of attention to them in education and research. Still we are not getting the best results from this. Valuable research results, for example, are published in scientific journals and presented at conferences. But there is still much to be done in translating those results into concrete care and guidance for patients. Moreover, dieticians, physiotherapists and other colleagues do not yet work together as a matter of fact,' says Peter Weijs. 'Voeding & Beweging NU will help us to link two disciplines and to better connect science and its application in practice. We focus on healthcare professionals, researchers and teachers'.

An example. Physiotherapists and dieticians both play an important role in the recovery of patients' infection with the COVID virus. Yet it was not yet customary to discuss patient data with each other

and to come to a joint approach. This is what Amsterdam UMC, AMS and the HvA started doing together within VBNU. Another example is the nutrition of oncology patients who are preparing for an operation. Parties involved in Voeding & Beweging NU created an information package for this group. Nutrition and exercise treatment is integrated and knowledge gained from research is disseminated in training courses for healthcare professionals. The results of the research are implemented in care practice and vice versa'.

A personalized approach

'The optimal combination of nutrition and exercise contribute enormously to improvement of health status,' says Hinke Kruizenga. 'With this new collaboration, we expect to be able to realize much more integrated and personalised care than before. For young and old. For people with obesity and for people who are at risk of malnutrition. Preventively and during illness or after surgery. For people recovering from major surgery and for athletes preparing for a top performance. In all these areas, there is still much to be gained and together we have set to work hard. Many projects have been developed: for example *2Do - Lifestyle approach* for elderly with Type 2 Diabetes and Obesity. Or *Walk and talk*, a walking and lifestyle program around transplantation from the desire to give more attention to active lifestyle. Also *Enhancing Muscle POWER in Geriatric Rehabilitation* is an important project. The number of people over 60 years of age will triple in the next 30 years. This project gains insight into sarcopenia awareness, feasibility and health effects of a combined nutrition and exercise program.

A broad training curriculum

We also realized a broad training curriculum to offer knowledge, insight and experience to unravel the complex interactions between diseases, nutrition & exercise and to intervene appropriately. The lecturers are dieticians, doctors, physiotherapists and researchers from the Amsterdam UMC and HvA. They share their expertise and knowledge of theory and practice.

Peter Weijs: 'In short, we want to achieve true integration of disciplines in order to work on the development of care paths, guidelines and internals for diagnostics and evaluation. We must work together to ensure that researchers cooperate optimally and that the results are translated into practice for the benefit of the patient. Amsterdam Movement Sciences plays a key role in this. AMS provides funding and brings people and disciplines together'.

Fundamental Research

"If you examine lower back pain from one discipline you will never discover how it is put together"

Jaap van Dieën, Professor Neuromechanics Faculty of Behavioural and Movement Sciences, VU

The main focus of our research into lower back pain is: what causes back pain to become chronic? For a large proportion of patients, the complaints become chronic. This results in restricted functioning. The strange thing is that up until now this has always been studied from a monodisciplinary perspective. The whole healthcare system is structured in this way. The person you meet determines your treatment. The orthopaedist gives a different treatment from the anaesthetist, for example. 'Who you see is what you get'.

A biosocial perspective

The problem is that there are often several factors involved in why the symptoms become chronic. You may be dealing with an interaction of biological, psychological and/or anatomical damage. If you look at it only from the point of view of anatomical damage, you will not solve the problem. Also, if you look at the problem only from a psychological perspective you are not going to solve it either. What is needed is a biosocial perspective, which has never been done properly in research. We want to measure all possible predictors of low back pain and ultimately arrive at a personalised treatment. The study will identify the underlying factors, which requires a very large cohort of patients aged 18 to 65.

The theme of movement is also important in this context. One aspect is whether movement can lead to low back complaints, the other is how movement

changes as a result of low back complaints. We have submitted an NWA application for this, which unfortunately was not awarded, and have reworked it into a Gravity application.

Mechanism behind the paradox

My own research in this area is: how does movement change as a result of low back pain? The clinical view focuses on one part of the problem: people move differently with low back pain and this should, according to the prevailing view, be normalised by the treatment. I don't believe in that, I think that pain is a biological mechanism that has an adaptive function. Moving differently could also be protective. People with lower back pain often have strengthened reflexes of lower back muscles and that protects their back from disturbances. At the same time, they move less precisely. That is a wonderful paradox. I have recently found the mechanism behind this paradox. An as-yet unpublished explanation is that these reflexes are controlled by sensors in the back muscles, which measure your movements. Then a reflex is generated to correct your posture. This reflex is stronger in people with back pain. Those sensors measure the length of the muscle very locally. So they do not measure the whole picture; there is always noise on that signal. If the sensor starts to amplify, the noise amplifies too. If there are no disturbances, the amplification of the noise leads to a loss of precision. As soon as there are disturbances, the net effect is positive, because you are better able to counteract those external disturbances. By strengthening your feedback, you strengthen the internal disturbances in your body, but you reduce the effects of the external disturbances. You are also less sure of yourself.

An interdisciplinary approach

When people are afraid of pain, reflexes go up. Variability in undisturbed movement also goes up. This is where mechanics and psychology come together; if you investigate this separately, you will never discover how it all fits together. Unfortunately, we don't just investigate it separately, we also treat it that way. Fear and the experience of pain can sustain each other. People need to regain confidence in their own movement. It has been clinically proven in lower back pain that continuing to move has a positive effect. We are also conducting a study with a military rehabilitation centre in Doorn. People with back complaints are given stabilising exercises. In addition to the normal exercises, people are also given exercises to move very precisely with a sensor. What seems to happen is that these people gain more confidence and are also better off clinically, so have less limitations and pain. That can give more self-confidence, is still partly speculative, but it does fit the picture that we have found from more experimental research.

It would be good if in the future a patient could have an interdisciplinary team around him. The nice thing about AMS is that it looks at a problem from those different angles and you see a lot of complementary values there. You just need this to tackle these kinds of diverse complex problems. The crisis in healthcare is that they cannot solve the complex problems monocausally. Within an ageing society this is an important issue.

"How to measure exploration in movements?"

Nina van Mastrigt, PhD candidate FGB, VU

Nina works as a PhD student on Katinka van der Kooij's project entitled: *The dark side of reward: physical rehabilitation by reward absence and punishment*. She focuses on the role of exploration in motor learning of balance tasks. In her experiments, she gives participants the task to score points by leaning or reaching towards a target. Participants only hear whether they were successful or not. How do participants explore? How do they vary their movements to find which movement leads to success?

Nina: 'We give participants a learning task. For instance: to score a goal in football. We just say whether someone is doing something right or wrong. People start trying out: they start varying their movements. You can learn from this variability. But since humans are always noisy in their movements, this "trying out", or "exploration", is difficult to measure. We came up with a way to measure exploration. We look at how variable people are following success, and following failure. People are always variable, or noisy, which we can quantify following success. Following failure, people start trying out. This extra variability on top of motor noise is what we call exploration.

Next steps are to discover how exploration and motor noise are related to learning. Katinka is already studying how experts and novices differ in their exploration and motor noise. Does someone like Messi have much less noise in his movements and therefore can control everything? Or/and is he much better at trying out and learning well from that? Another approach is to increase people's movement speed, as we know that people become more variable when they are in a hurry. Is this extra variability noise, or exploration? And how does speeding up affect learning?'

David Mann, Associate Professor, Faculty of Behavioural and Movement Sciences VU, Motor learning & Performance

What you see is not what you get

'The degree of visual impairment does affect performance in Paralympic judo. In particular, completely blind athletes seem to be at a disadvantage under current regulations. This is evident in our research, that has prompted the development of a new competition structure for Paralympic judo, namely separate classes for completely blind and still partially sighted athletes. The new regulations are expected to be in place by the 2024 Paralympic Games in Paris. Kaj Krabben, with his thesis entitled: What you see is not what you get, made a big contribution to that.

Visual impairment distinction

Judo is one of the most popular Paralympic sports for athletes with visual impairment. Currently, the classification of Paralympic judo competitions does not differentiate according to the degree of visual impairment. Visually impaired and totally blind judokas compete in the same class, with no knowledge of the extent to which this affects the fairness of competition. This has now been investigated.

In recent years, we have been researching the influence of visual impairment on performance within judo sport. The research was conducted in cooperation with the International Blind Sports Federation and the International Paralympic Committee. We tested both athletes with and without visual impairment on their visual function and judo skills. We also analysed a large amount of competition results and conducted interviews with Paralympic athletes, coaches and referees.

Paralympic sports

The International Paralympic Committee's vision is to create an inclusive world through sport. Fair competition is essential for the legitimacy of Paralympic sport and the promotion of the Paralympic vision. Paralympic sports allow athletes with disabilities to compete fairly and are divided into different classes based on type and degree of disability'.

Stephan van der Zwaard, assistant professor in data science and exercise physiology.

How data science can help to better understand the exercising humans

Sports data has changed a lot in recent years. Data collection has boomed: camera systems can track players' positions, activity trackers can help to monitor daily activities, and applications have been developed to monitor well-being or training load from athletes. In addition, Athlete Management Systems help to combine data from multiple sources and athletes into one system.

Developments in data analytics have not stood still either. In recent years, artificial intelligence, data science and machine learning have made their appearance in sport. These techniques help to make predictions and discover underlying and sometimes invisible patterns in data. For example, sport has gained more insight into recognition of training stimuli for optimal performance, tactics and individual injury risks.

In 2019, Stephan van der Zwaard (assistant professor at FGB) has set up the new master's course 'Data in Sport and Health', in which students get to work hands-on on solving a data science puzzle of a practitioner from sport or healthcare. Last year, VU and Leiden University published personalized machine-learning models in elite volleyball, providing relevant predictors for overuse injury, such as cutoffs to avoid symptoms of injury during certain strength training exercises. Besides injuries, these data science techniques also give more insight into match performance. This gives the coach and athlete tools to adjust their training sessions.

Currently a training study in recreational cyclists is ongoing, investigating how training adaptations differ between individuals and how cyclists can make the best progress: with endurance training alone, endurance training with traditional strength training or with eccentric strength training. Based on physiological properties and machine learning models, individual training adaptations will be modelled to better understand how each individual adapts and what factors may play an important role in this. In short, data science provides (potentially) additional tools to better understand how people optimize their performance.

Public Private partnerships

Prof. Theo Smit, professor of Translational Regenerative Medicine

Prof. Gino Kerkhoffs, professor of Orthopedic Surgery and Sports Medicine, Amsterdam UMC

An injectable implant to reduce damage and pain of osteoarthritis

Osteoarthritis is a chronic joint condition that affects more than 500 million people world-wide. There is as yet no treatment that can stop or reverse the damage, and many patients eventually receive a joint replacement. Is an earlier and less radical solution possible?

Theo Smit investigates the role of mechanics in development and disease. He studies the physical origin of biological shape and musculoskeletal diseases like scoliosis and osteoarthritis. He aims to regenerate biological tissues by creating optimal mechanical conditions with degradable materials.

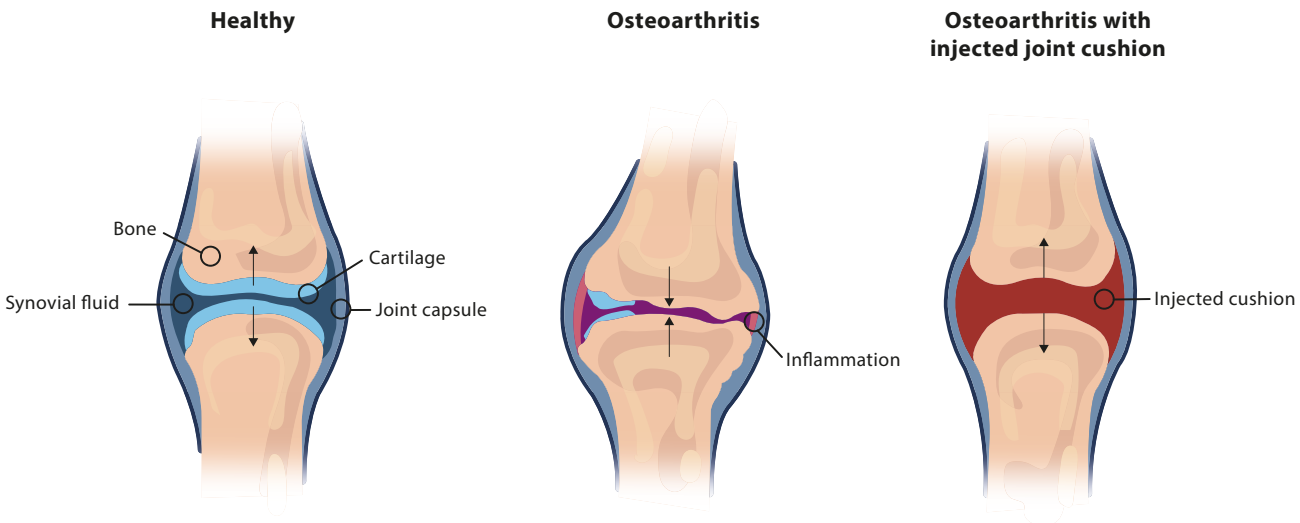
Sport orthopedist Gino Kerkhoffs often sees elite athletes, dancers and other young patients after chronic overloading or acute trauma like ankle sprains or fractures. Such events cause superficial cartilage damage that over the years may develop into disabling ankle osteoarthritis. What happens in their joints?

Trauma induced osteoarthritis

'Cartilage essentially consists of proteoglycans, sugar-like molecules that attract and bind water. Swelling is counteracted by collagen fibers that provide cartilage its sturdiness. When cartilage is impacted, the collagen bundles snap and the internal pressure is lost, leaving a superficial soft spot. When this bruise is loaded by the activities of daily life, cells within the cartilage become deformed, become inflammatory and break down more matrix. The bruise gets worse, eventually resulting in osteoarthritis.' Can this be prevented?

An injectable elastic implant

'To breach this chain of events, the cells within the cartilage must shift from a degrading to a regenerative mode. For this, the hydraulic pressure of the cartilage needs to be restored. Some six years



ago, we figured that this could be achieved by a cushion that reduces and distributes the joint loads. A tough, elastic hydrogel could do the job. Such a gel must be injectable, stand the loads of daily life, and be degradable after 6-8 weeks. The temporary cushion not only restores the mechanobiology of the cells, but also reduces the pain in the joint. We involved dr. Tonny Bosman of SupraPolix BV to materialize this idea.'

Indications that it works

'We have indications from earlier work that this mechanical approach works. We injected enzymes into intervertebral discs to induce degeneration. Cells became inflammatory and produced matrix degrading enzymes. Then we injected a hydrogel to restore the hydrostatic pressure. Cells stopped being inflammatory and started to produce new collagen and proteoglycans. This should also work in other joints. We now have a material that is injectable, fills the joint well, and becomes elastic after hardening. When applied in an animal, we see no host reaction and safe degradation after six weeks. This means that the hydrogel can be injected several times, if necessary.'

Prevention

'Until now, the role of mechanics in osteoarthritis is underestimated and funding is difficult. If our concept is right, we can address cartilage degeneration at a much earlier stage and at much lower costs. This is not only relevant in sports medicine, but also for elderly people who have to wait for a joint replacement or are reluctant to undergo surgery. An injectable implant can reduce the pain and increase mobility, which increases general health and quality of life.

From Holocue to CueX

dr. Melvyn Roerdink

Associate professor Technology in Motion, PI projects Holocue and CueX

dr. Daphne Geerse

Postdoc project Holocue and CueX, Parkinson expert, MDR specialist

Lotte Hardeman

PhD student project CueX

Bert Coolen

R&D engineer, developer of Holocue's AR and AI

Jara van Bergem

Research Assistant project Holocue

dr. Berno Bucker

Dedicated IXA business developer projects Holocue and CueX

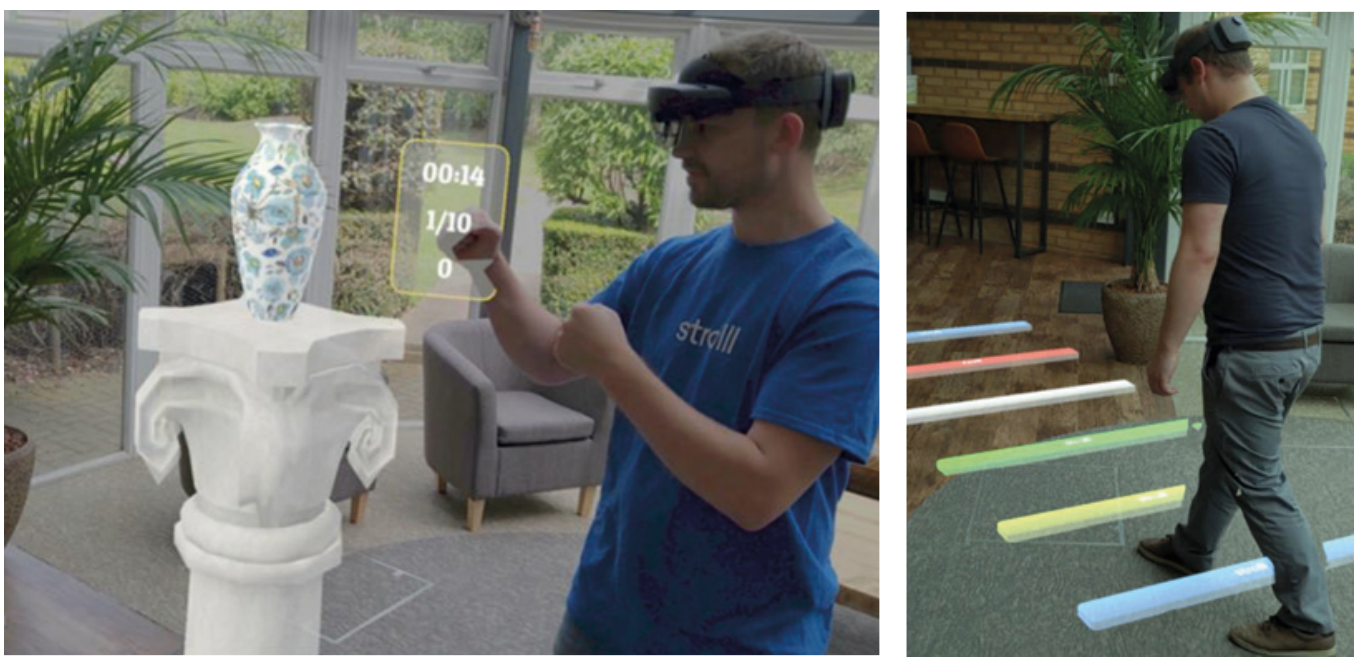
Team: **dr. Melvyn Roerdink** (PI, associate professor Technology in Motion), **dr. Daphne Geerse** (postdoc), **Lotte Hardeman** (PhD student), **Bert Coolen** (PhD student, R&D engineer), **Jara van Bergem** (research assistant), **dr. Berno Bucker** (business developer IXA)

An augmented-reality medical device to assist and promote mobility in people with Parkinson's disease

Melvyn Roerdink and his team work hard towards making an impact through research and education. Business partners play an essential role in this. Mervyn's Roerdinks group is started to collaborate with Stroll on an Eureka Eurostars research project in order to improve patient's quality of life and make a significant societal impact. The product has the potential to be a game-changing innovation. It contains the right elements to significantly alleviate the burden of Parkinson's on patients, their families, and clinical care by leveraging powerful Augmented Reality and Artificial Intelligence technologies to improve daily cueing-enabled gait assistance.

For the VU Amsterdam, the collaboration is a hugely excellent opportunity with the potential for significant real-world impact, building on project Holocue led by dr. Roerdink and transferred to Strolll for commercialization to positively impact the quality of life of people affected by Parkinson's disease. At VU, the societal impact of academic work is being highly valued, a lot is being expected from our partnership with Strolll in that regard. Currently more shared grant applications with Strolll are being prepared, and they also intend to finance a PhD candidate in the near future.

Schematic showing Holocue in action: a person with Parkinson's wearing augmented-reality glasses approaches a freeze-prone location (here a sudden narrowing of the walkable space), calls for cues through a voice command (cues on) upon which action-relevant visual cues appear in his augmented-reality field of view blended with the real environment to help traverse this difficult situation by stepping onto the cues (a goal-directed movement known to prevent freezing).



Schematic showing CueX for home-based AR gait-and-balance therapy (left panel, AR boxing as one of the many gamified AR gait-and-balance exercises) and AR cueing (right panel)

"This new method prevents unnecessary surgeries in knee replacement surgery"

Leendert Blankevoort, Associate Professor Orthopaedic Surgery, Amsterdam UMC

In 2021, my colleagues Matthias Schafroth, Arthur Kievit and I, from Orthopaedic Surgery and Sports Medicine and Iwan Dobbe, Geert Streekstra and Clarisa Sanchez from Biomedical Engineering and Physics applied for a grant for research into a treatment method for osteoarthritis, which was honoured by Top Sector Life Sciences & Health. They support innovative research and development realized by public-private partnerships (PPPs).

Is surgery required?

'We received this grant for diagnostics of knee replacement loosening. In the event of complaints with a knee prosthesis, it is often thought that the prosthesis is loose. In 20 to 30 % of the cases however, during the operation it turns out that this is not the case. The pain has a different cause. An adequate diagnosis has thus not been made. But it also works the other way round: sometimes adequate treatment is denied if there is uncertainty about the stability of the prosthesis. Therefore, we want to ensure that patients who need surgery are actually operated on'.

Losening of knee prothesis

'Until now, there has been no method of doing this properly. After hip replacement, knee replacement is the most common joint replacement operation. About 10% of patients have complaints indicative of loosening of the prosthesis. We know that the strain is greater in younger people because they are usually more active and have a longer life expectancy, so there is a greater chance of the prosthesis getting loose. The quality of the prosthesis has improved

over time, but the problem is the higher demand of patients with respect to their activities. It is often said that such prostheses last 15 years, but this is different for each patient'.

A load in different directions

'We invented and developed a method to determine how much the prosthesis is loose, consisting of a loading device and software. The device we developed exerts a load twice in different directions on the knee. This causes the TKA component to move relative to the bone. At each load, a three-dimensional X-ray scan – CT-scan – is made of the knee. The scans are analysed and the motion of the prosthesis relative to the bone is calculated by means of advanced software. This motion is included in the diagnostic process. Excessive motion indicates loosening'.Of course, the physical functioning of the patient is also taken into account. X-rays are taken to see how the bone relates to the prosthesis.

Correct, faster and cheaper diagnosis

'This project aims to further develop this method and apply it in daily practice, as analternative to current diagnostic methods. We are preparing the loading device and software for the market, testing the method in hospitals in the diagnostic process in collaboration with OrthoKey BV. We also examine the use of artificial intelligence for the automatic processing of theCT scans and determine the accuracy of the diagnosis. That is what our goal is: a correct diagnosis in a fasterand cheaper way. An effective treatment and a faster return to normal pain-free daily activities, work and recreation'.

PhD Enthusiasm

Tim Veneman, chairman PhD Committee

Tim Veneman is a PhD candidate at the department of Rehabilitation Medicine of the Amsterdam UMC, location AMC, and is chairman of the PhD committee, which exists since 2017. 'The main goal of the committee is to create more interaction and cooperation between researchers within the institute. A platform that helps PhDs to meet, interact and collaborate. Meeting other PhDs and learning about their projects can be inspiring, stimulate collaboration and enhance peer support. Amsterdam UMC and VU are both represented within the PhD committee.'

'2021 was a year dominated by COVID-19. Despite the challenges of organizing events during the pandemic, we had an interesting Spring Meeting in May. It was online, with almost 50 participants. The main theme was: 'reverse thinking'. If you face issues, how can you tackle them in a creative way? The event was highly appreciated and a great help to resolve problems with a positive and creative attitude. The event ended with an online pub quiz. While enjoying some drinks and snacks, groups of PhD's competed against each other to win a worthy price.

We also organized four workshops with Karin Herrebout, on how to give a good online presentation. This turned out to be very useful. Researchers hardly get any training in storytelling, while this can be an important attribute for research presentations. The workshop was highly appreciated and highly anticipated, with more applications than available places. Therefore, we want to provide this workshop again in the future.

In September we organized a Ping Pong event, a more informal meeting, to play table tennis, to network and to get to know each other better. This is one of the key roles we have as committee, to inspire each other and to create partnerships. After a long Covid lockdown, we were glad to finally have the possibility to organize a physical meeting again. Unfortunately in December the lock down was in place again, and we had to cancel our annual PhD Day. We have sent a book and a present to all who had registered for this event, as a token of appreciation for the effort they made for AMS during the year. The PhD event was postponed to May 2022. Despite the challenges COVID presented, 2021 was overall a successful year with fruitful (online) educational and networking events. The goal for the future is to increase our visibility, organize more events and workshops and to intensify cooperation with postdocs.

Members of the PhD Committee in 2021: **Anne Reuten**, **Laure Verstraeten**, **Ruben de Ruiter**, **Marijke de Leeuwerk** and **Tim Veneman**.

Grants

Personal Grants

Dr. ir. Pim van Ooij (Amsterdam UMC - Location AMC) in 2020 received a personal VIDI grant of €810.000 from the Dutch Research Council (NWO), for the project Less aortic motion in a diseased thoracic aorta. The grant was unfortunately not included in the AMS annual report 2020, which is why it inlisted in this year's report. The thoracic aorta moves constantly under heart motion and blood flow which in a stiff, diseased aorta can lead to tearing. This research focuses on the development of novel MRI technology to map aortic motion and stiffness in three dimensions to improve risk assessment for lethal aortic events

MDI/ZonMw grant for Hein Daanen

Professor dr. Hein Daanen (VU Amsterdam), was in 2021 awarded a grant of €242.000 by ZonMw for the project *Warmly Recommended (Warm Aanbevolen)*. The grant is a collaboration with TNO (the Netherlands Organisation for applied scientific research), both Radboud and Maastricht Universities, and other partners. The main objective of this project is to establish an action perspective that minimizes adverse temperature-related health effects, with special attention to behavioral components and high-risk groups.

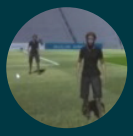
ZonMw grant for Karin Gerrits

Karin Gerrits, research coordinator at Merem, received a ZonMW grant of €79.515 for the project: "Implementation of personalized training for patients with non-acquired brain injury: FITopMAAT". This will lead to a strong connection between science, education and clinical practice, which allows better and more rapid implementation of scientific knowledge.

MIT subsidy for analysis of smart system for exercise motivation

Fitsurance, a VU start-up, has been awarded a RVO MIT feasibility subsidy of €20.000 from the Provincie Noord Holland. With this financial contribution Fitsurance will investigate the feasibility of a Reinforcement Learning system that analyzes the best method to motivate individuals to exercise more.

NWO Take-off Grant for David Mann



The development of athletes in team sports can be accelerated by the use of virtual training tools. These training tools are especially promising for the improvement of tactical skills. In this project a virtual 3D room (VROOM) is developed to enable tactical training within soccer by using an extended reality (XR) training tool that displays soccer situations in a 3D space.

IMDI/ZonMw grant for Mirjam Pijnappels

IMDI/ZonMw awarded a grant of €150.000 (and €157.000 cofounding, in total €307.000), to support research on wearable technology to optimize prognostic evaluation and rehabilitation of gait behaviour in orthopaedic patients, conducted by **dr. Mirjam Pijnappels** (VU Amsterdam).

ZonMW grant of 3 million euro for research on burn wounds

This grant will be used to further improve the care for burn patients. With the grant the three Dutch burn centers (Groningen, Beverwijk and Rotterdam) will intensify research into the timing of skin grafting, the research on artificial skin and implementation of self-management.

Grant for call in optimization of ankle-foot orthotic stiffness

Merel Brehm, **Niels Waterval**, **Frans Nollet** and **Jaap Harlaar** have been awarded a IMDI grant of €327.429 in the category 'Technology for humanized care: demonstration projects'. The project focuses on developing a wearable, stiffness-adjustable ankle-foot orthosis.

TKI-PPP Grant for Comforthod

A grant from €656.892 has been awarded to **Leendert Blankevoort**, Orthopaedic Surgery Amsterdam UMC and his team for research on an innovative tool to diagnose loosening of a total knee arthroplasty. The Amsterdam UMC TKI grants for PPP projects are available to all Amsterdam UMC researchers and aim to perform more research projects in collaboration with companies in Public-Private Partnerships (PPP). See interview page..

Eureka grant for Melvyn Roerdink

Melvyn Roerdink and collaborators were awarded £450,000 Eureka Eurostars grant, to support stroll in developing the technology further and providing funding for VU University to complete clinical feasibility trials of the resulting product. It was an application for mixed-reality glasses to assist, train & improve gait in Parkinson's patients.

Dr. Sicco Bus (Amsterdam UMC, location AMC), was in 2021 awarded several grants, a ZonMW grant of €460.870 for the project GGH, and €95.201 for the project *Focus on Feet.*

Dr. Sonja de Groot (VU Amsterdam) and collaborators were awarded a grant of USD411.144 for the project *Meaningful changes in fitness, functional independence, and transfer independence as defined by individuals living with spinal cord injury.* The project is financed by the US Department of Defence, and is a collaboration with U. of Alabama at Birmingham.

Dr. Erwin van Wegen (Amsterdam UMC, location VUmc) was awarded €399.971 by the Dutch Hersenstichting for the project *HIIT_Effect op stemming ParkMS.*

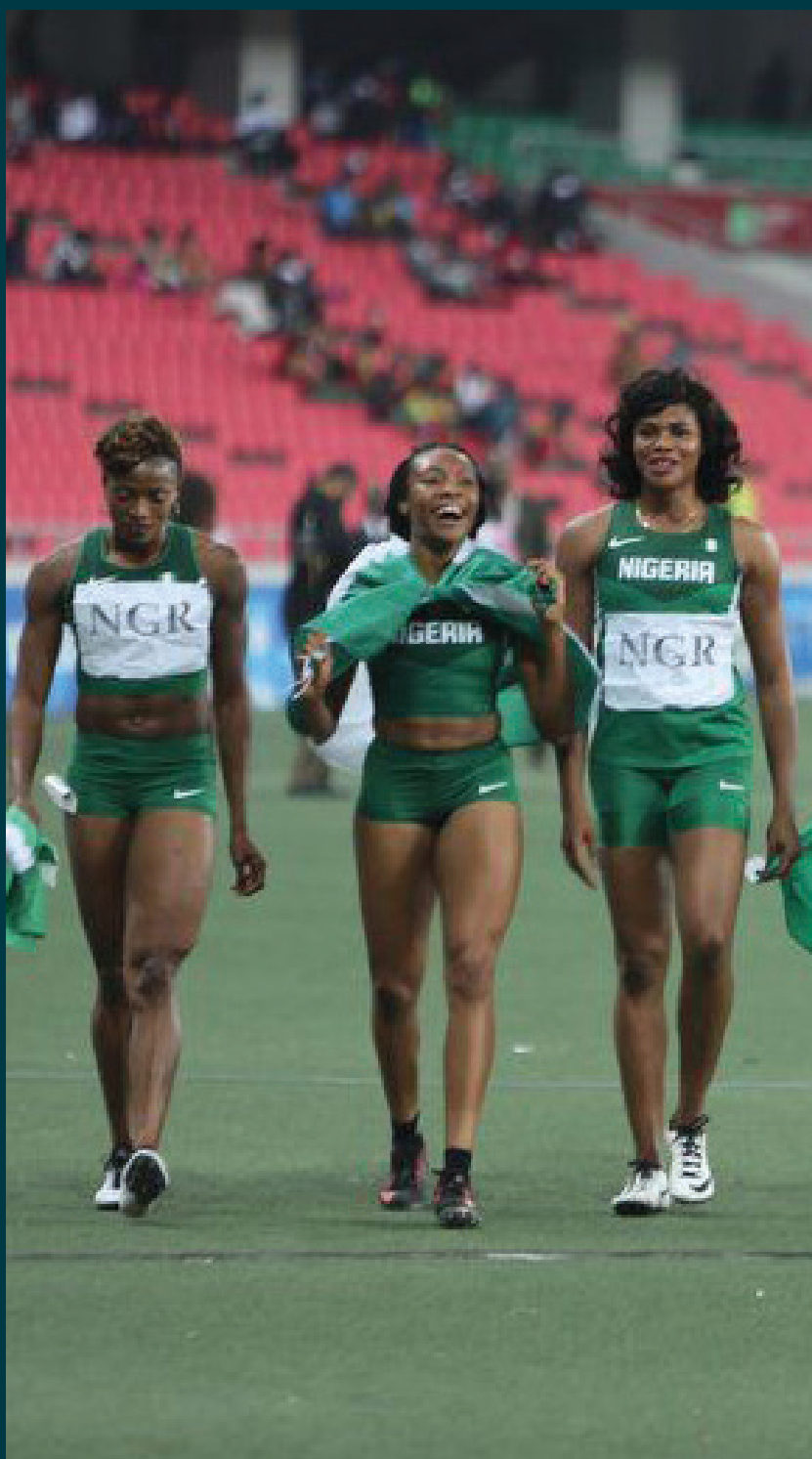
Dr. Merel Brehm (Amsterdam UMC, location AMC) and collaborators were in 2021 awarded a grant of €206.652 by Stichting Life Sciences Health – TKI for the project *ADJUST,* as well as a ZonMw grant of €116.668 for the project *GGH - 3D orthoses.*

Professor dr. Raymond Ostelo (VU Amsterdam), was in 2021 as Co-PI given a grant of €300.000 by taskforce for Applied Research SIA (RAAK-MKB), for the project *Measurement in primary care* (Slimmer Scoren, in de eerstelijns fysiotherapiepraktijk). The grant was given in collaboration with Dr. H. Wittink, Utrecht U. of Applied Sciences.

Anke Mennen (Amsterdam UMC, location AMC) was awarded an Amsterdam UMC PhD Scholarship of €216.000 to carry out a full time PhD research project on pelvic fractures in children an d the elderly.

Dr. Geert Streekstra (Amsterdam UMC, location AMC), was by TTW: Toegepaste en Technische Wetenschappen awarded a grant of €150.971 for the project *Demonstrator*.

Dr. Paul Kuijer (Amsterdam UMC, location AMC), was awarded a grant of €100.000 by the Ministry of Defence for the project *KMAR Vit & Vitaal*.



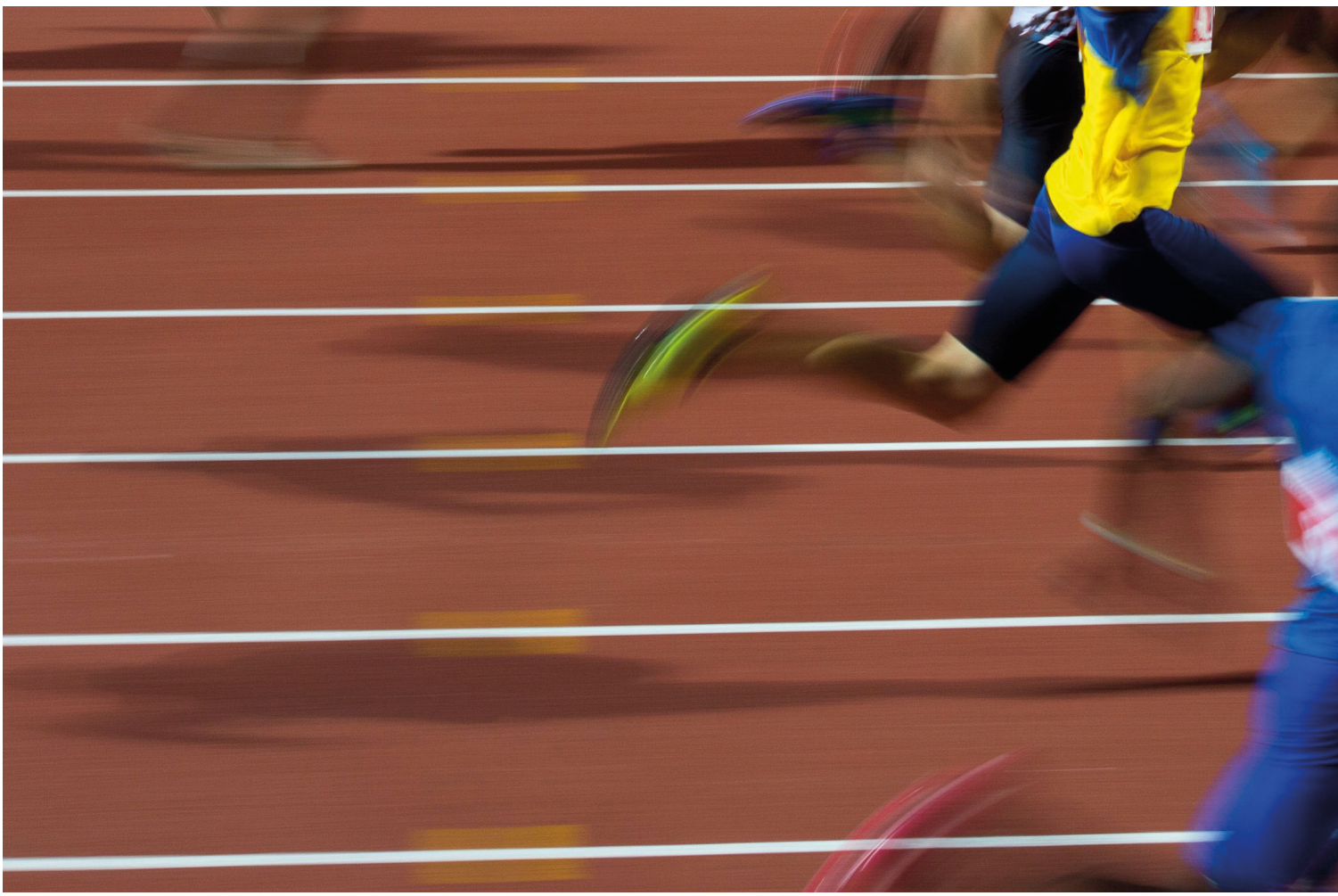
Prizes

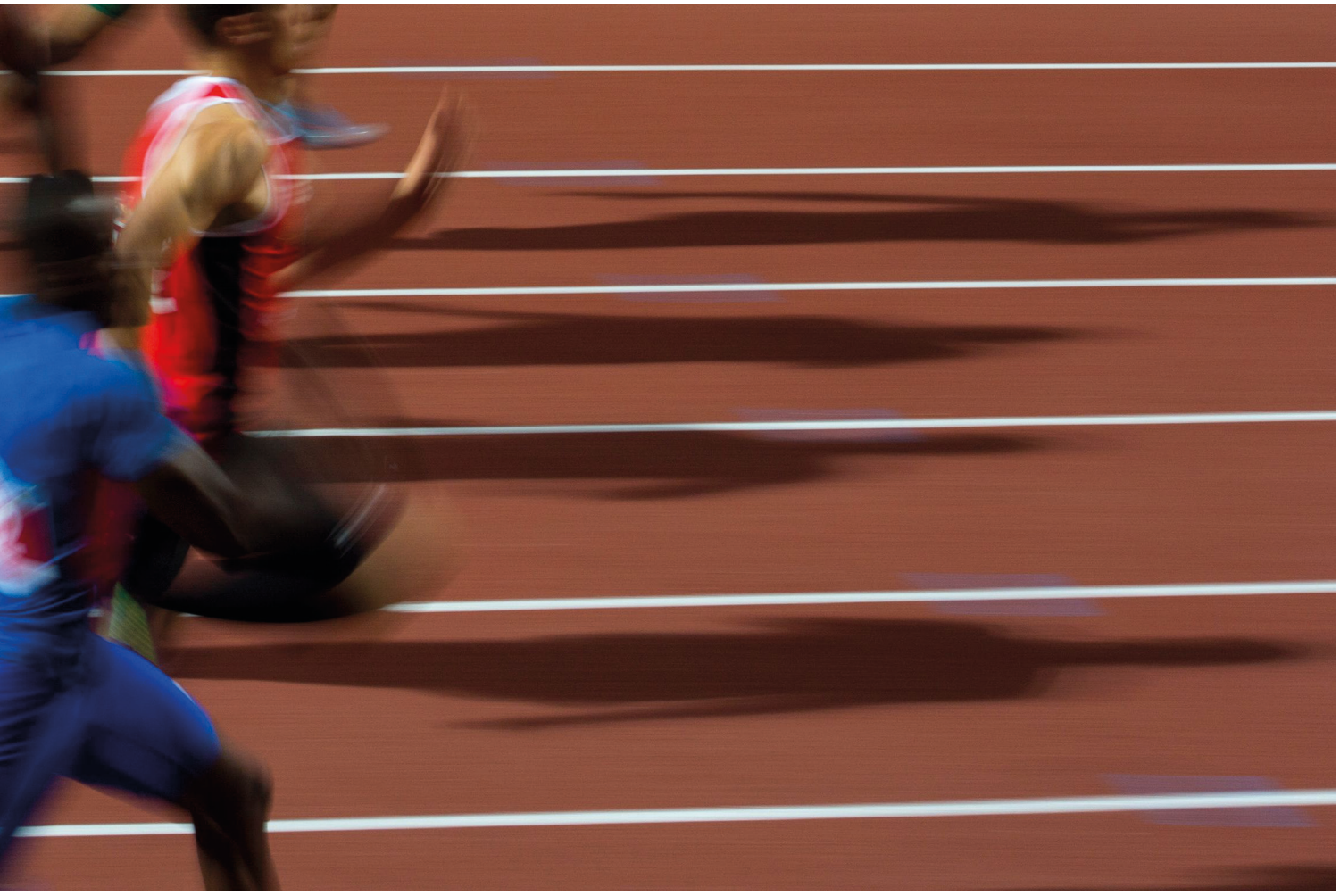
SB Prize for Guido Geusebroek

Guido Geusebroek PhD Candidate FGB VU, has won a prize at the ISB (International Society of Biomechanics) meeting from the Hand and Wrist Biomechanics International technical group ($300). He presented his MSc thesis work entitled *Force transmission via intertendinous linkages of the m. flexor digitorum profundus*. Co-authors are **Dirkjan Veeger** and **Huub Maas** The ISB promotes and supports international contacts among scientists, the dissemination of knowledge, and the activities of national organizations in the field of biomechanics.

Best oral presentation for Jaap van Netten

At the 17th scientific online meeting of the Diabetic Foot Study Group of the European Association for the Study on Diabetes, the largest yearly conference on the topic, **Jaap van Netten** has won the price for ‹Best Oral Presentation›, for his talk on the ‹Cost-effectiveness and cost-utility of foot temperature monitoring for the prevention of diabetic foot ulcer recurrence: a randomized controlled trial›. During this talk, he presented the findings of the economic analyses of the DIATEMP-trial, also on behalf of his co-authors **Wouter aan de Stegge** **Marcel Dijkgraaf** and **Sicco Bus**.





Appointed Professors

Carel Meskers appointed professor of Rehabilitation Medicine

His research focuses on movement disorders in patients after a neurological injury and in aging patients. This often involves an interplay between the 'controller' (the nervous system) and the 'motor' (the muscle). Understanding this interplay is of great importance to get patients independent as soon as possible and as long as possible. This research is conducted in cooperation with a large number of partners within VUmc, TU-Delft, rehabilitation centres and the business community. The chair is embedded within the Department of Rehabilitation Medicine, Division 5 of Amsterdam UMC.

Peter Bisschop appointed professor Professor of Internal Medicine UvA

Bisschop studies the neuroendocrine regulation of bone metabolism. In neuroendocrinology he studies the interplay of hormones and nerves.
Simply put, this field is about how hormones affect the brain and nerves and how that in turn affects organ metabolism.

Richard Jaspers appointed professor Molecular and Translational Exercise Physiology

As head of the Myology Laboratory, **Richard Jaspers** has extensive expertise in both basic and applied research on musculoskeletal tissue function and adaptation. His research spans multiple biological levels, from cell to organ to the whole body and translates mechanistic insights into strategies to improve movement performance in rehabilitation and sport. Throughout his career, Richard has demonstrated the ability to successfully collaborate in multidisciplinary teams.

Other Appointments

Annemieke Buizer appointed PI

Her scientific research in pediatric rehabilitation medicine centers on improving interventions to promote activities and participation in children with a motor disability. A specific focus is on cerebral palsy and related childhood movement disorders. Cerebral palsy is the most common motor disability in childhood, and has a range of causes with the common denominator of stable early brain damage or -malformation, with life-long consequences. Much is still unknown about what the best treatment is for the individual child, and a lot is to be gained by a better understanding of the underlying causes and impairments.

Jack van Loon appointed to the United Nations Office for Outer Space Affairs

Gravity researcher **Jack van Loon** (AMS/VUmc/ACTA). Van Loon researches how cell processes develop under the influence of very low or, to the contrary, very high gravity and what influence this has on human health.

Mario Maas Vice President of ESSR

In June 2021, **Mario Maas** has been appointed Vice President of ESSR (European Society of Musculoskeletal Radiology). ESSR stimulates the cooperation between medical and non-medical professionals who are active in furthering the development of musculoskeletal radiology, the field in which Mario Maas specializes, where he focuses on sports, education and metabolic development.

Sidney Rubinstein appointed research committee vice-chair

As associate professor and leading epidemiologist at VU Amsterdam he became a member of the World Federation of Chiropractic (WFC) Research Committee, in February 2021. The mission of the WFC is to provide information and other assistance in the fields of chiropractic and world health.

Awards

Zinnige Zorg Award

IkHerstel is an app that helps patients recover after surgery. The app is developed by the Amsterdam UMC researchers Judith Huirne (professor Obstetrics and Gyneacology), Han Anema (professor Public and Occupational Health) and Jeroen de Wilde, director of the spin-out company. The app is currently being evaluated for knee arthroplasty patients in the ACTIVE trial, by the team of Carlien Straat (PhD candidate), with Jantine Maarleveld, Pieter Coenen, Judith Huirne, Han Anema, Gino Kerkhoffs and Paul Kuijer.

AMS Awards

In 2021 there were two winners of the **Outstanding Paper Award.** **Sabrina Chettouf** got the award for the paper: *Are unimanual movements bilateral?* This study shows that unimanual movements involve bi-hemispheric activation patterns that resemble the bilateral neural activation typically observed for bimanual movements. The second Award was won by **Ton Schoenmaker**, entitled: *Activin-A Induces Fewer, but Larger Osteoclasts From Monocytes in Both Healthy Controls and Fibrodysplasia Ossificans Progressiva Patients.* This research is a well-performed trial with innovative and clinically meaningful results for a rare and complex disease.

During the **AMS Annual Meeting** prizes were awarded in three different categories. **The Best Poster Award** in **Sports** was won by **Tammie van Biemen**, entitled: *Into the eyes of the referee: A comparison of on-field visual search behaviour between elite and sub-elite football referees.*

In **Clinical Science Victor Staartjes** won also with his Poster: *Magnetic resonance imaging-based synthetic computed tomography of the lumbar spine using deep learning*. Finally, in Basic Science, **Moritz Eggelbusch** won with his research: *inflammation-induced skeletal muscle wasting: emerging role of the nlrp3 inflammasome*.

The (first) **Societal Outreach Award** was won by Eric Voorn. He took the lead in the development and implementation of 'B-FIT', a training guide to prescribe and evaluate individualized home-based aerobic training in slowly progressive neuromuscular diseases.

AMS Investment Grant for Aart Nederveen

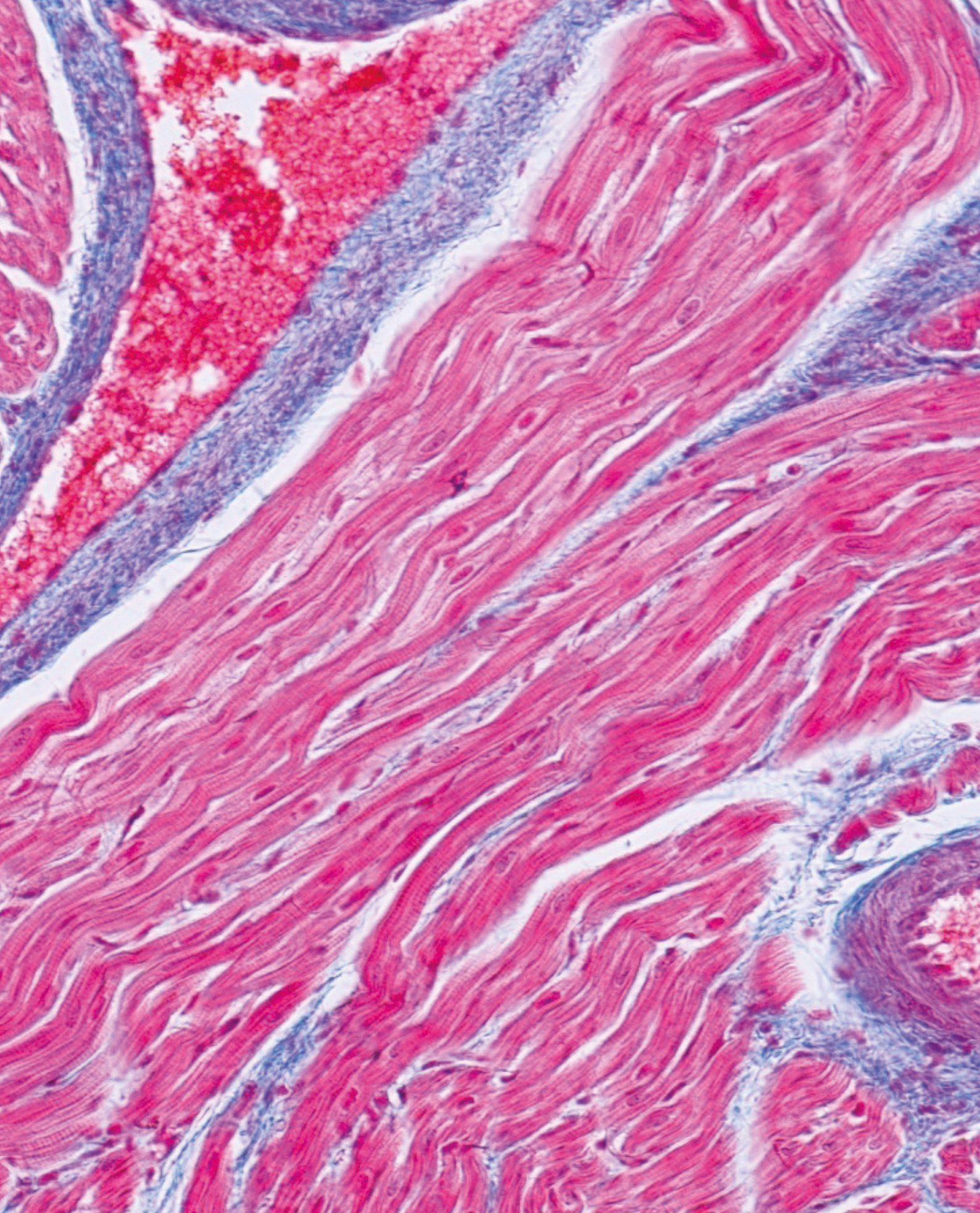
The proposal was submitted to the 2021 round of the AMS-VUmc investment call, for the purchase of a Double-tuned 31P/1H receive coil for a 3 Tesla MR system and has been approved for the requested amount of €32.000.

AMS Investment grant for Wendy Scholten-Peeters

The second grant in the AMS-VUmc investment call was given to Wendy Scholten-Peeters (Movement Sciences, VU). The proposal of €12.030 was submitted for the purchase of a Conditioned Pain Modulation (CPM) equipment consisting of a refrigerated circulator cold water, with a digital algometer (Somedic type II).

Research Master Awards for Anne Strating, Matthijs van der Laan, Britt van Hees and Braeden Charlton

The AMS awards were handed out by to four candidates. Anne Strating's proposal is entitled *Why your workout is not working: Skeletal muscle mitochondrial cristae impairments in people with type 1 diabetes mellitus*, FGB: Mathijs van der Laan's proposal is entitled: *The ins and outs of cardiopulmonary exercise testing*. The title of Britt van Hees's proposal is: *Mind the Gap: Measuring Electromechanical Delays of the Pelvic Floor*. Braeden Charlton's proposal carries the title: *Viral infections and muscle metabolism: low NAD+ as possible new avenue for therapeutic intervention in patients with PASC*. Congrats to all!



Membership Base

AMS MEMBERSHIP BASED****	Full Professor*,**	Endowed Professor	Associate Professor*,**	Assistant Professor*,**	Lecturer*	Medical Specialist*,**	Other Academic Staff*,**	Physician*,**	Research Associate*,**	Visiting Professor	Visiting Fellow*,**	Total Staff & ECR	Standard PhD Candidate*,**,***	MD-PhD / Promoverende medewerkers*,**,***	External PhD Candidate*,**,***	Total PhD candidates*,**,***	Sum Total AMS members
AMC	17	0	3	2	0	31	21	0	16	0	0	90	103	7	0	110	200
Vumc	20	1	8	4	2	29	3	16	13	0	22	118	27	9	46	82	200
VU	14	4	13	23	5	0	0	0	18	0	11	88	38	6	92	136	224
UvA/HvA	2	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	3
AMS	53	5	24	29	7	60	25	16	47	0	33	299	168	22	138	328	627

AMS publications

AMS activities

Injections with plasma rich plasma not effective for ankle osteoartritis

JAMA Publication for Sports Physicians and Orthopedic Surgeons

An injection into the ankle joint with Platelet Rich Plasma (PRP) does not work better in ankle osteoarthritis than an injection with saline. This is the main conclusion from a multicenter RCT, initiated and coordinated at the Amsterdam UMC. The results were published October 26, 2021 in the Journal of the American Medical Association (JAMA). Injecting PRP has been a popular therapy for joint, muscle and tendon disorders. Sports physician and lead researcher Hans Tol, conducted the PRP study together with Gino Kerkhoffs, Sjoerd A. S. Stufkens, Liam D. A. Paget and Guus Reurink and Bergman Clinics, Erasmus MC, Flevoziekenhuis, OLVG and Spaarne Gasthuis.


4th Annual Research Meeting
Amsterdam Movement Sciences
March 18, 2021
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VU
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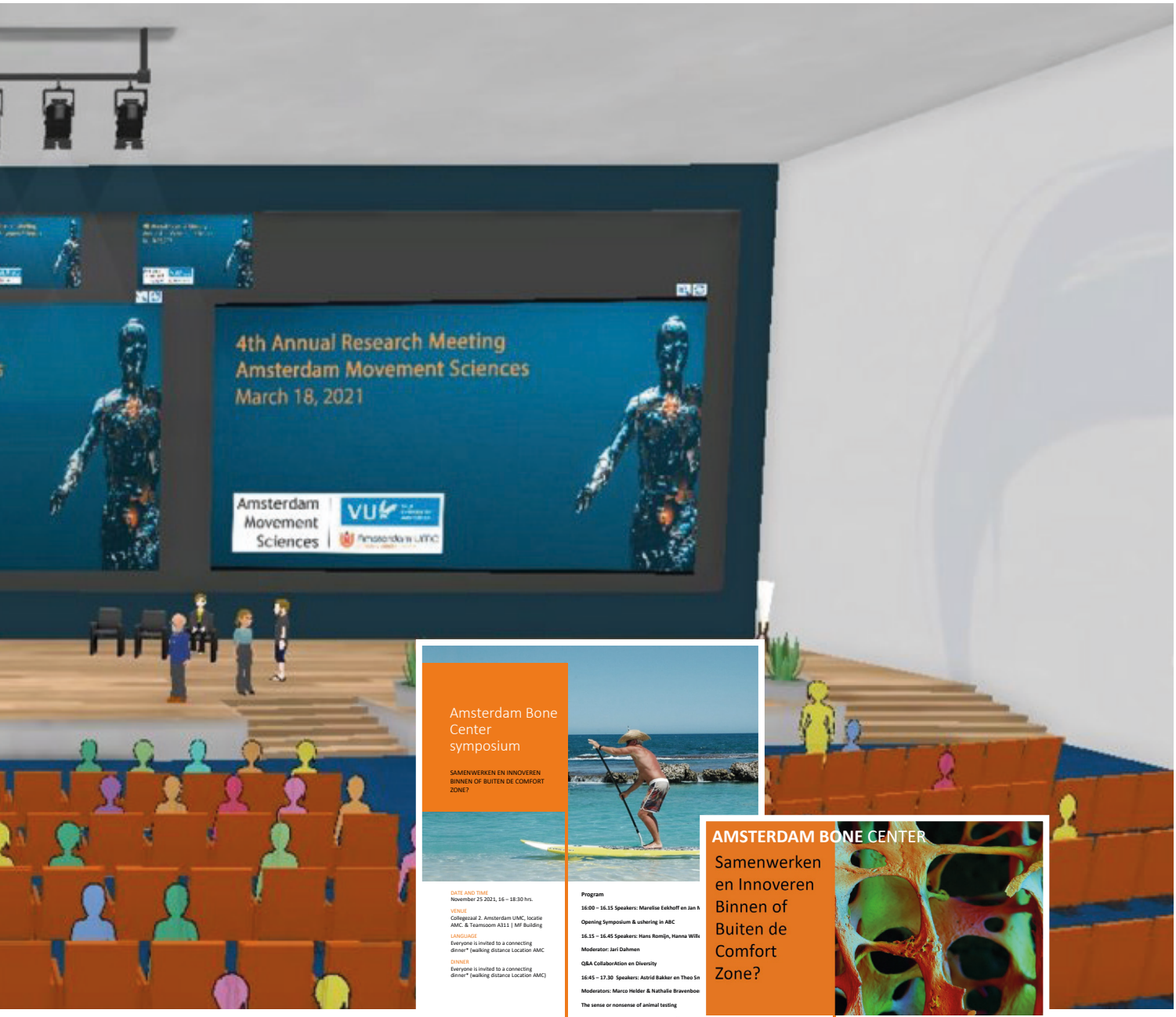
VU
SpeakerAMS



Amsterdam Bone Center symposium

SAMENWERKEN EN INNOVEREN BINNEN OF BUITEN DE COMFORT ZONE?

DATE AND TIME
November 25 2021, 16 – 18:30 hrs.

VENUE
Collegezaal 2. Amsterdam UMC, locatie AMC. & Teamsoom A311 | MF Building

LANGUAGE
Everyone is invited to a connecting dinner* (walking distance Location AMC

DINNER
Everyone is invited to a connecting dinner* (walking distance Location AMC)

Website: .
http://www.amsterdamumc.org/ams

Program

16:00 – 16.15 Speakers: Marelise Eekhoff en Jan M

Opening Symposium & ushering in ABC

16.15 – 16.45 Speakers: Hans Romijn, Hanna Wille

Moderator: Jari Dahmen

Q&A CollaborAtion en Diversity

16:45 – 17.30 Speakers: Astrid Bakker en Theo Sn

Moderators: Marco Helder & Nathalie Bravenboe

The sense or nonsense of animal testing

17:30 – 17.45 Speakers: Marelise Eekhoff & Richa
Mario Maas (AMS)

Relation Amsterdam Movement Sciences & Amst
Center

Amsterdam Movement Sciences

AMSTERDAM BONE CENTER

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The sense or nonsense of animal testing

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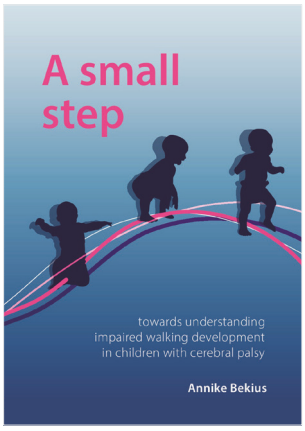
Relation Amsterdam Movement Sciences & Amsterdam Bone Center

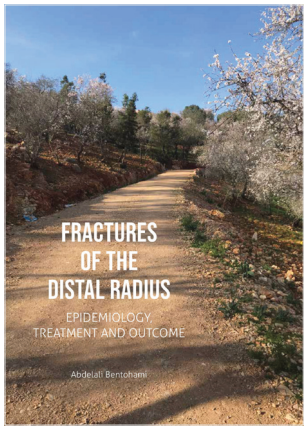
17:45 – 18:30

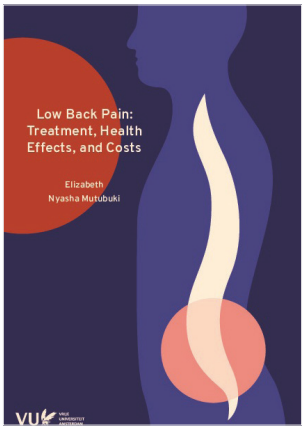
Closure and drinks

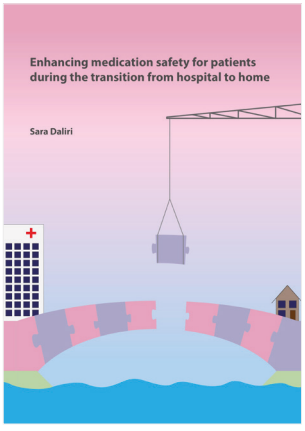
Amsterdam Movement Sciences | VU | Amsterdam UMC

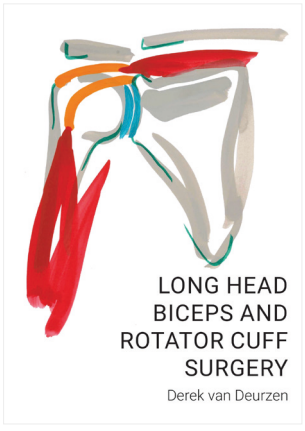
AMS dissertations

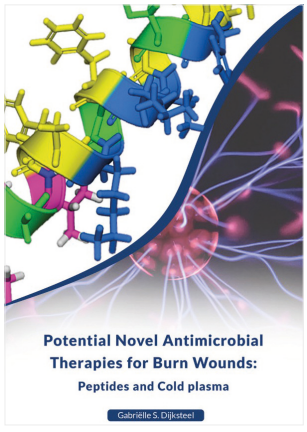


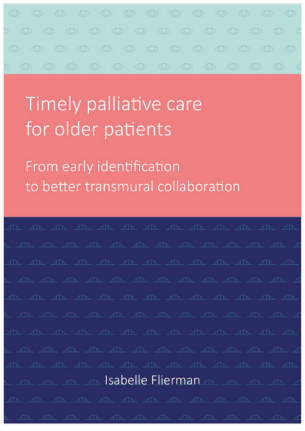


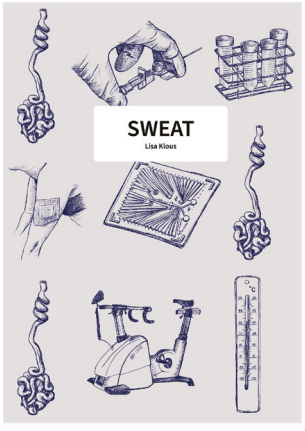


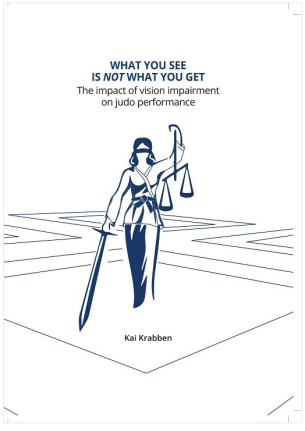


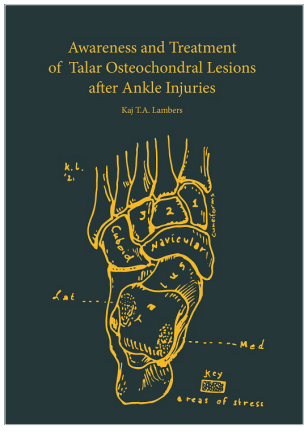


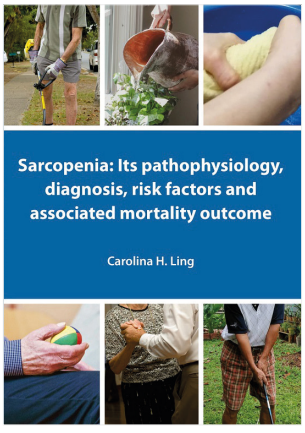




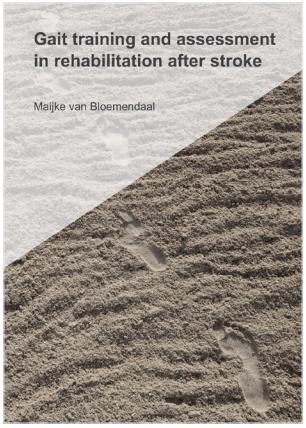


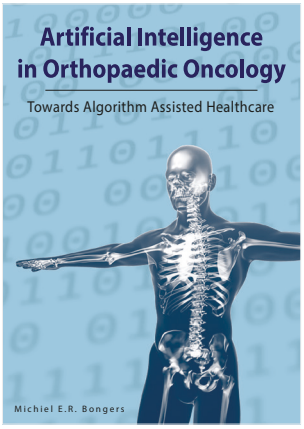


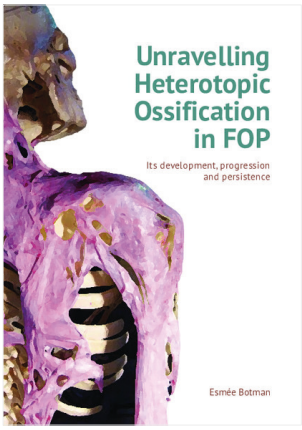


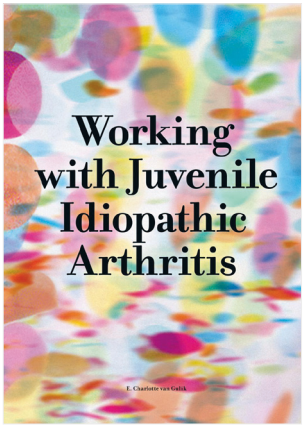


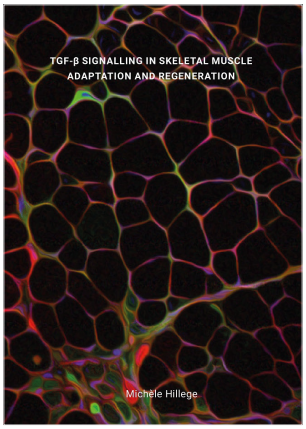

WHO STAYS FIT?
Incidence, risk factors and prevention of sports injuries in physical education teacher education students
SANDER BLIEKENDAAL


Gait training and assessment in rehabilitation after stroke
Maijke van Bloemendaal

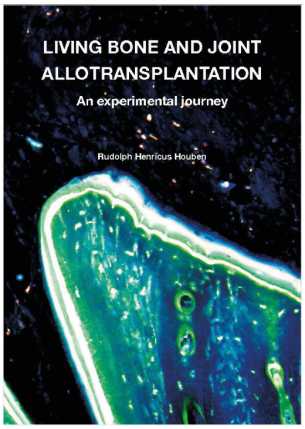

Artificial Intelligence in Orthopaedic Oncology
Towards Algorithm Assisted Healthcare
Michiel E.R. Bongers

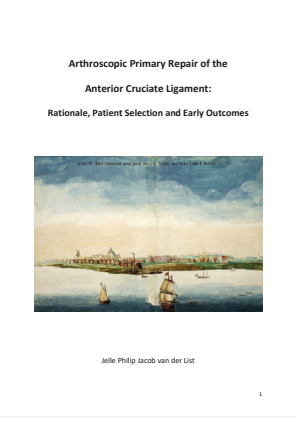

Unravelling Heterotopic Ossification in FOP
Its development, progression and persistence
Esmée Botman

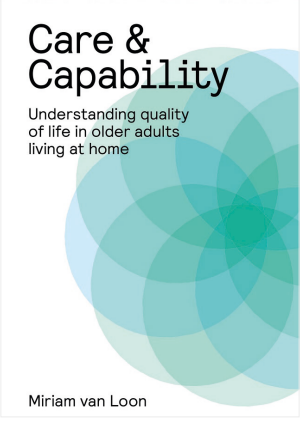

Working with Juvenile Idiopathic Arthritis
E. Charlotte van Gulik

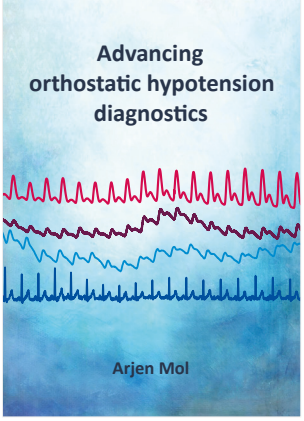

TGF-β SIGNALLING IN SKELETAL MUSCLE ADAPTATION AND REGENERATION
Michèle Hillege

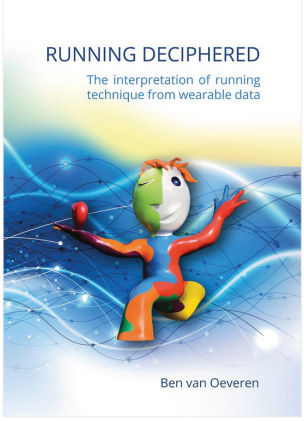

OPTIMISING TREATMENT OF YOUNGER, ACTIVE KNEE OSTEOARTHRITIS PATIENTS
- surgical options and functional outcomes -
Alexander Hoorntje

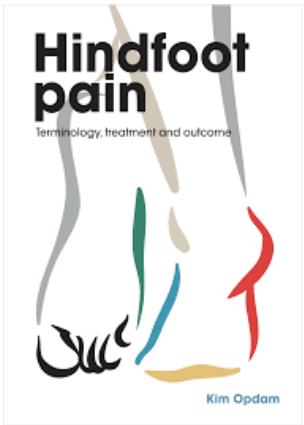

LIVING BONE AND JOINT ALLOTRANSPLANTATION
An experimental journey
Rudolph Henricus Houben

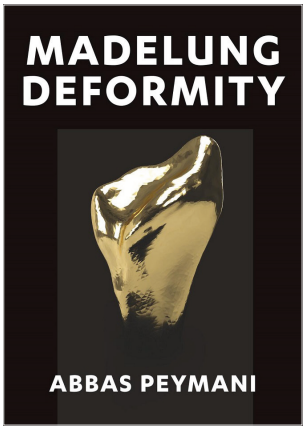

Arthroscopic Primary Repair of the
Anterior Cruciate Ligament:
Rationale, Patient Selection and Early Outcomes
Jelle Philip Jacob van der List

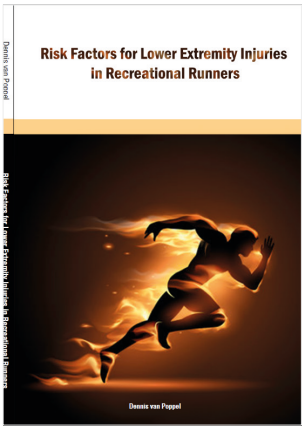

Care & Capability
Understanding quality of life in older adults living at home
Miriam van Loon

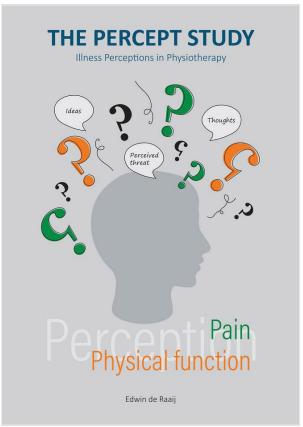

Advancing orthostatic hypotension diagnostics
Arjen Mol

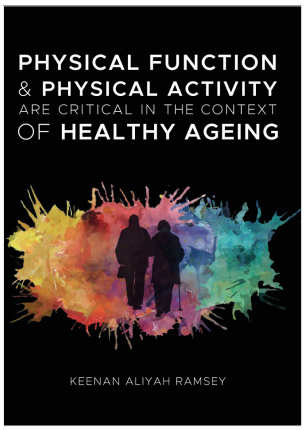

RUNNING DECIPHERED
The interpretation of running technique from wearable data
Ben van Oeveren

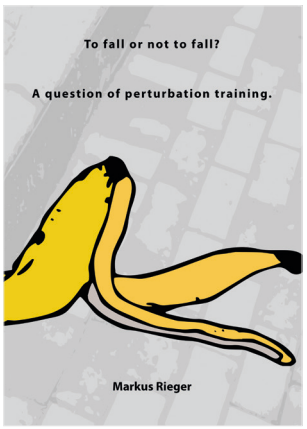

Hindfoot pain
Terminology, treatment and outcome
Kim Opdam

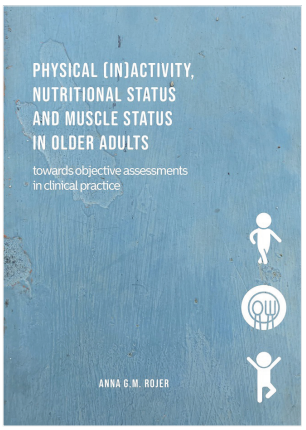

MADELUNG DEFORMITY
ABBAS PEYMANI

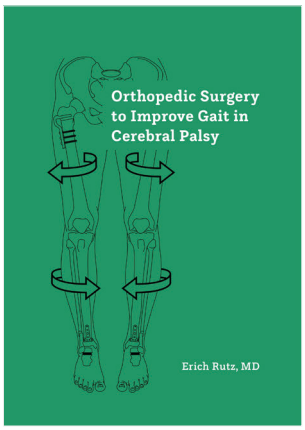

Risk Factors for Lower Extremity Injuries in Recreational Runners
Dennis van Poppel

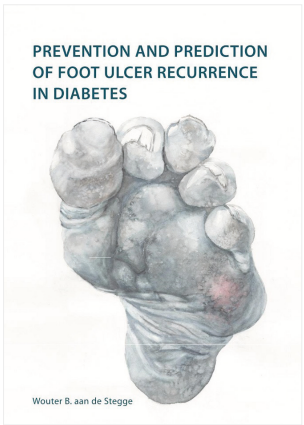

THE PERCEPT STUDY
Illness Perceptions in Physiotherapy
Ideas
Thoughts
Perceived threat
Pain
Physical function
Edwin de Raaij

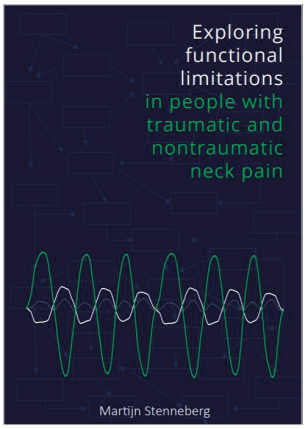

PHYSICAL FUNCTION & PHYSICAL ACTIVITY ARE CRITICAL IN THE CONTEXT OF HEALTHY AGEING
KEENAN ALIYAH RAMSEY

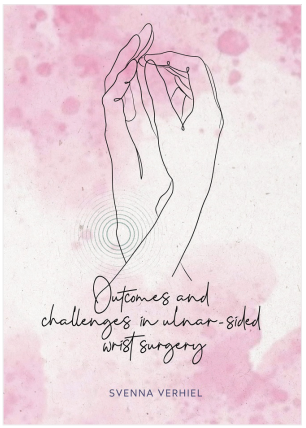

To fall or not to fall?
A question of perturbation training.
Markus Rieger

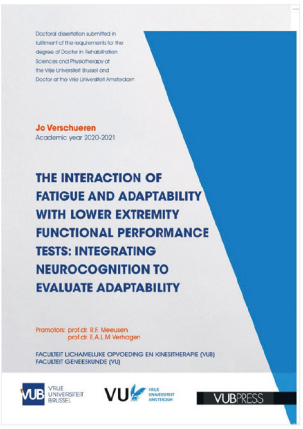

PHYSICAL (IN)ACTIVITY, NUTRITIONAL STATUS AND MUSCLE STATUS IN OLDER ADULTS
towards objective assessments in clinical practice
ANNA G.M. ROJER

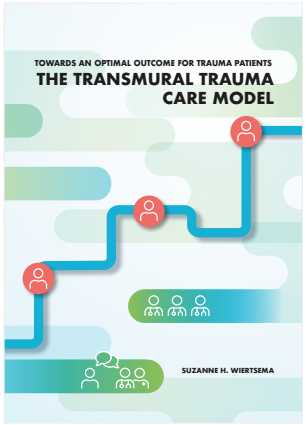

Orthopedic Surgery to Improve Gait in Cerebral Palsy
Erich Rutz, MD

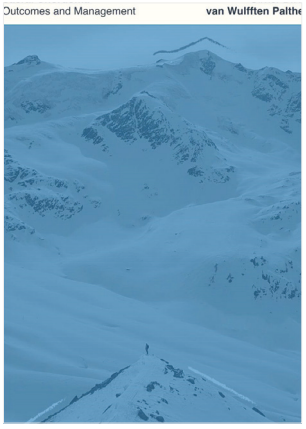

PREVENTION AND PREDICTION OF FOOT ULCER RECURRENCE IN DIABETES
Wouter B. aan de Stegge

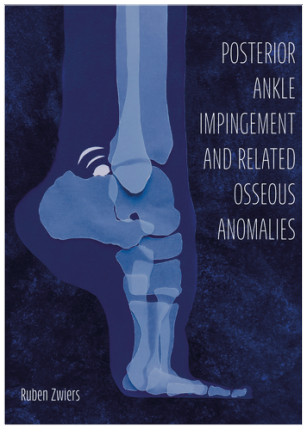

Exploring functional limitations in people with traumatic and nontraumatic neck pain
Martijn Stenneberg


Outcomes and challenges in ulnar-sided wrist surgery
SVENNA VERHIEL


Jo Verschueren
Academic year 2020-2021
THE INTERACTION OF FATIGUE AND ADAPTABILITY WITH LOWER EXTREMITY FUNCTIONAL PERFORMANCE TESTS: INTEGRATING NEUROCOGNITION TO EVALUATE ADAPTABILITY
VUB PRESS


TOWARDS AN OPTIMAL OUTCOME FOR TRAUMA PATIENTS
THE TRANSMURAL TRAUMA CARE MODEL
SUZANNE H. WIERTSEMA


Outcomes and Management
van Wulfften Palthe


POSTERIOR ANKLE IMPINGEMENT AND RELATED OSSEOUS ANOMALIES
Ruben Zwiers

AMS in the press

Lower back pain, what is effective?

Interview with Raymond Ostelo. Volkskrant.

Is having a cold shower healthy?

Interview with Hein Daanen in De Morgen.

‘Eerst rennen dan scannen’ RTL Nieuws.

Exercising for at least two to three hours a week is healthy. But how many hours of sport can your body handle at most? To find out, cardiologists at AMC Amsterdam are conducting research into exercise in people running a marathon.

Andrea Maier about ageing, our health and government policy.

Vrij Nederland.

Big boys don’t cry.

Mental health problems in top athletes are not that exceptional. The new Canvas series ‘The price of the winner’ proves that once again. In it, Belgian (former) top athletes speak out about eating disorders and emotional abuse by coaches. In football too, star players are gradually trying to break the taboo. Interview with, among others, Gino Kerkhoffs