Arthritis UK
(Formerly Versus Arthritis)

# Biomechanics and Bioengineering Research Centre

## Impact Report

# Restoring our joints step by step

**Our joints are complex structures, containing various tissues and fluids that work together to produce movement. Healthy joints rely on a number of things, including how they move during our everyday actions.**

This is why abnormal joint movement can negatively affect our joint health. And when our joint health deteriorates, this can lead to osteoarthritis and other musculoskeletal issues. However, why some types of abnormal joint movement contribute to the onset or progression of conditions like osteoarthritis is not fully known. If we knew more, poor movement patterns could be identified and corrected, while encouraging protective movement patterns. This important field of work is known as biomechanics.

For many years we've known that mechanical loading, inflammation and pain contribute to osteoarthritis. However, the biological processes that link these factors were unknown. Advanced tools like 3D motion capture, gait analysis and inertial measurement units were used in research, but rarely in the clinic. Surgery to treat osteoarthritis existed but techniques were inconsistent and long-term data was lacking to understand which surgeries are best and why. The impact of joint injury and joint surgery on our biomechanics and biology, and the subtleties in gait or alignment that could contribute to long-term disease, was also unclear.



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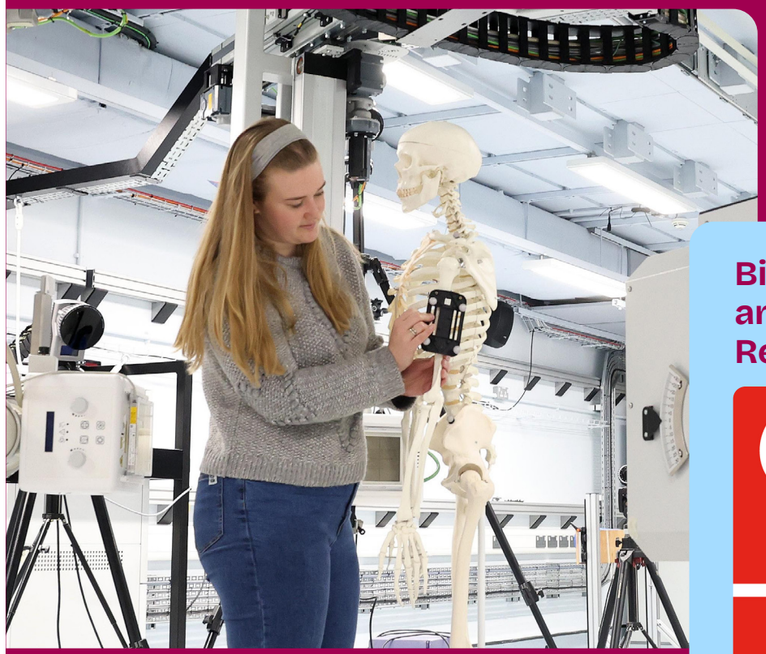
# Enter our Biomechanics and Bioengineering Research Centre in Wales

The Centre was established at Cardiff University in 2009 with £4.5 million infrastructure funding from Arthritis UK to build capacity, address unanswered scientific questions, seek additional funding, embed patient and public involvement and build networks. Since then, under the leadership of Professors Duance, Caterson and Sparkes, the Arthritis UK Biomechanics and Bioengineering Research Centre has led a unique, interdisciplinary programme of research and translation aimed at helping people with musculoskeletal conditions live better.



**Biomechanics and Bioengineering Research Centre**

CARDIFF UNIVERSITY

PRIFYSGOL CAERDYDD

**The Biomechanics and Bioengineering Research Centre has been a leader in cross-disciplinary research as we believe that the best way to tackle the problem of arthritis and other musculoskeletal disorders is through working together and sharing expertise.**

We are privileged to work with people with arthritis and other musculoskeletal disorders. They are at the heart of our research programmes, and we thank all those who participate in our studies. Our clinical research partners at Cardiff and Vale Orthopaedic Research Centre, led by Mr Chris Wilson, Consultant Orthopaedic Surgeon, and staff in the Physiotherapy Department at the University Hospital of Wales, have enabled patient-based research that is at the cornerstone of all our studies.

We are particularly proud of our legacy in the training of PhD and MD students who are continuing working in the NHS, Academia and Industry across the globe to help people with arthritis.

**Professor Valerie Sparkes,**
Centre Director

**Professor Cathy Holt**
Director of Biomechanics Research

**Professor Deborah Mason**
Director of Pre-Clinical Research



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# The Arthritis UK Biomechanics and Bioengineering Research Centre is investigating ways to

# Our research impact areas

New knowledge

Influence on policy and practice

New networks

Leveraged funding

Increased capacity to conduct research

Patient and public involvement

New intellectual property, products and services

## £4.5m of Arthritis UK funding has led to:

More than

**275**

publications cited more than 9,000 times.

More than

**£27m**

leveraged funding.

More than

**125**

staff and students gained further qualifications.



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# 01

# Boosting the success of surgery

## Why is this important to people with arthritis?

**Not everyone with arthritis will need surgery, but it may be offered to treat osteoarthritis. There are different types of surgery available that can help restore how our joints move, prevent the condition from getting worse and reduce pain.**

However, whether a particular surgery achieves this, and how this translates into improvements in day-to-day movement, is not fully understood. For example, for certain types of surgery, there is not strong proof as to what really works or why. This means it's hard to know how people can get the best possible results from surgery.

# Early-stage osteoarthritis: shifting the load

**Joints that don't move the way they are supposed to, such as those found in people with bowed legs (genu varum) or knock-knees (genu valgum), are at higher risk of developing osteoarthritis.**

One type of surgery that may be offered to people with bowed legs or early-stage osteoarthritis on the inner side of their knee is high tibial osteotomy (HTO). This surgery involves cutting and reshaping bone to shift weight away from the damaged part of the knee joint.

To improve this surgery and help people reach their best possible outcome, the Centre is gathering data about changes that occur following an HTO. By combining clinical, biomechanical and biological information from 50 HTO patients over 10 years, they've shown that this surgery successfully realigns the knee joint.

### HTO

- Increases walking speed and yet also decreases loading through the side of the knee joint affected by arthritis.
- Restores knee joint loading patterns, as we step from one leg to another whilst walking, in a way that would be expected to reduce further structural damage in the future.
- Regulates signals in the bone and joint fluids, which influence pain, inflammation and joint damage.
- Results in positive compensatory movement changes in our hips, leg bone and ankle.

**Over**

**3,000**

**patients recruited to registry.**

**15,000**

**sets of clinical records gathered.**

### Capacity building

The Centre helped establish the UK Knee Osteotomy Registry in 2014 – the world's first national registry dedicated to collecting outcome data for knee osteotomy procedures. One of the founders, Dr David Elson, worked with Centre members to recruit patients and gather clinical information. Since then, the registry has recruited over 3,000 patients and collected more than 15,000 sets of records.



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# Late-stage osteoarthritis: new joint, new you

**10m**

**adults in the UK have a probable diagnosis of osteoarthritis.**

**1 in 5**

**adults are not satisfied after total knee replacement.**

**Over**

**3,000**

**patients recruited across Centre studies.**

**10 million adults in the UK have a probable diagnosis of osteoarthritis, and total knee replacement (TKR) is one common treatment option for late-stage osteoarthritis.**

Most are satisfied after the procedure, but roughly one in five are not. Reasons for this include continuing pain or poor joint function. The causes of these issues are unclear, which is why the Centre investiagted TKR. This research showed:

TKR improves forward-backward movement in the knee, hip and ankle but does not restore range of motion fully.

- There's often a mismatch between perceived and measured improvement – feeling better isn't always the same as moving better. This is important to know because lingering abnormal biomechanics could cause problems in the future:
  - Nearly three in four people after TKR report feeling as good as healthy individuals, but less than a quarter experience fully restored knee movement.
  - Subtle movement abnormalities, picked up through objective tools like gait analysis, may persist despite feeling better. This highlights why gait analysis is important when assessing recovery to improve rehabilitation.

What's more, surgeons debate the best way to align the knee when they perform TKR; a perfectly straight leg versus recreating the leg's natural state before osteoarthritis. The best alignment may vary for different people and identifying the right approach could help to minimise or avoid pain, poor range of movement, and in severe cases the need for costly, revision surgery. That said, Centre research has found that:

Aiming for a perfectly straight leg after TKR improves how well the joint moves, creating smoother motions. This also improves how well the joint distributes weight whilst walking, potentially reducing joint pain and wear into the future.

# Not all implants are the same

Implants used for joint replacement surgery can be made from different materials, but most are fixed in place using cement. Joint implants typically last for decades, but some can fail within the first few years. One leading cause is infection. This is why antibiotic-loaded implants are commonly used and oral antibiotics may also be prescribed. Could a new type of cement help?

# New intellectual property

Dr Wayne Nishio, Senior Lecturer in Biomaterials at Cardiff University, has secured a worldwide patent for a new drug delivery system for bone cement – a substance that slowly releases more antibiotics than currently possible with existing technologies. This could help reduce implant infection, extend the lifespan of the implant, and possibly negate the need for people to take oral antibiotics – all of which would help save the NHS money and improve the experience for people receiving an implant.





# Wayne's story

**"I am a Senior Lecturer in Biomaterials at Cardiff University and joined the Centre in 2009 as a PhD student. I carried on studying this topic as a PostDoc with Centre support and have stayed at Cardiff University ever since."**

## Why is Wayne's research needed?

"Cement material used to prevent infections in joint replacements today are a simple combination of powdered antibiotics and cement mixture. It's a crude system that requires a lot of antibiotics which is expensive, releases in one short burst, and weakens the cement material. This can result in the replacement failing or becoming infected over time.

In fact, around one in ten joint replacements fail after ten years. My research is developing a more sophisticated way to deliver antibiotics in bone cement, which releases over a longer period, without compromising the material's properties. This could potentially make joint replacements last longer."

## What has Wayne found so far?

"Small particles called liposomes, which are made of the same molecules that make up our cell wall, can be infused in bone cement and used as a vehicle to deliver antibiotics. We have also found a way to manufacture and fill liposomes with drugs that target certain tissues and diseases. These discoveries have since been patented and are being progressed towards clinical use. We hope to next test it in humans so that we can get the evidence needed for regulatory approval and ultimately get it into the joints of people."

## What is Wayne working on now?

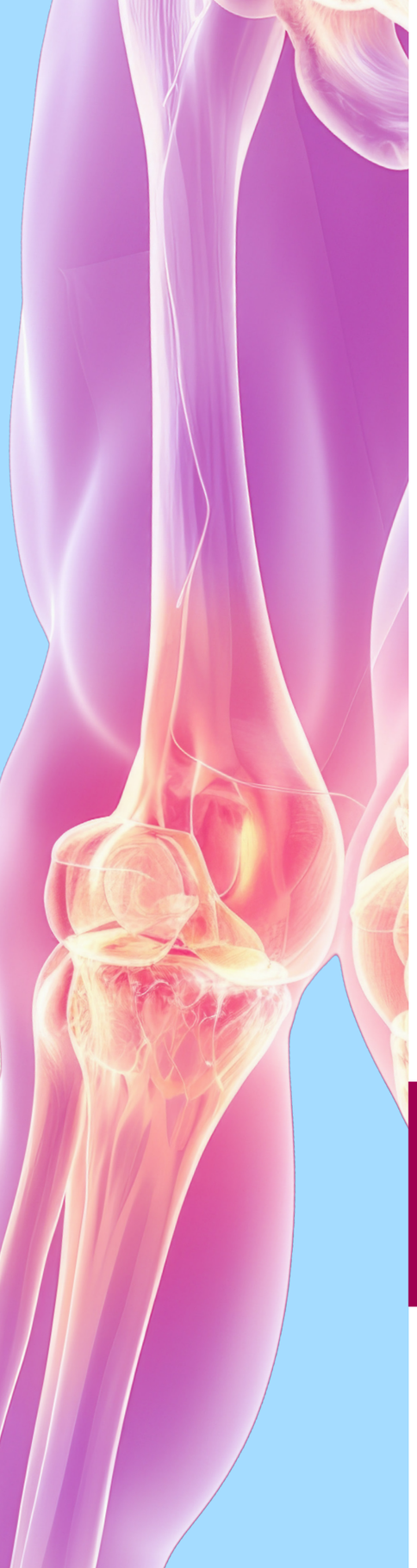
"Exploring ways to apply my bone cement research into dentistry. I am also investigating new ways to prevent infections in uncemented implants through novel drug delivery systems, coatings and textures. For example, we use inspiration from things found in nature like gecko skin and cicada wings because bacteria don't grow on them."

## How has being part of the Centre helped Wayne?

"The Centre has been instrumental in me gaining new skills, getting further funding and building my network internationally across disciplines. Through the Centre's involvement with the British Orthopaedic Research Society, I won a travelling fellowship to visit research centres in Hong Kong, Singapore, Australia and China which was an incredible experience. My favourite moment at the Centre has been the full circle moment when, after the Centre supported me to get a PhD, I managed to get my own PhD student funded through the Centre who recently graduated."

# 02

# Improving rehabilitation with cutting-edge technology



## Why is this important to people with arthritis?

**Recovery after joint injury and surgery can be challenging, but it's a vital part of getting the most benefit from the procedure.**

Physiotherapy is a cornerstone in the recovery from and management of musculoskeletal conditions and their interventions. But its effect can be limited. One reason for this is because tools that support people and physiotherapists to manage or assess their condition over time are inconsistent or lacking.





## New super lab making leaps in research

**To address this, Centre researchers are developing innovative tests, tools and services. Cutting-edge technologies are enabling them to push the boundaries of what could possibly be used to help people recover from joint injury and surgery better and faster.**

**£5m**

**awarded by the Welsh Government and Cardiff University to establish the Musculoskeletal Biomechanics Research Facility.**

### Leveraged funding

Centre investigator Professor Cathy Holt was awarded £5 million from the Welsh Government and Cardiff University to set up the Musculoskeletal Biomechanics Research Facility. The award was successful because of the Centre – its status, infrastructure, and the members' experience working with the NHS and patients.

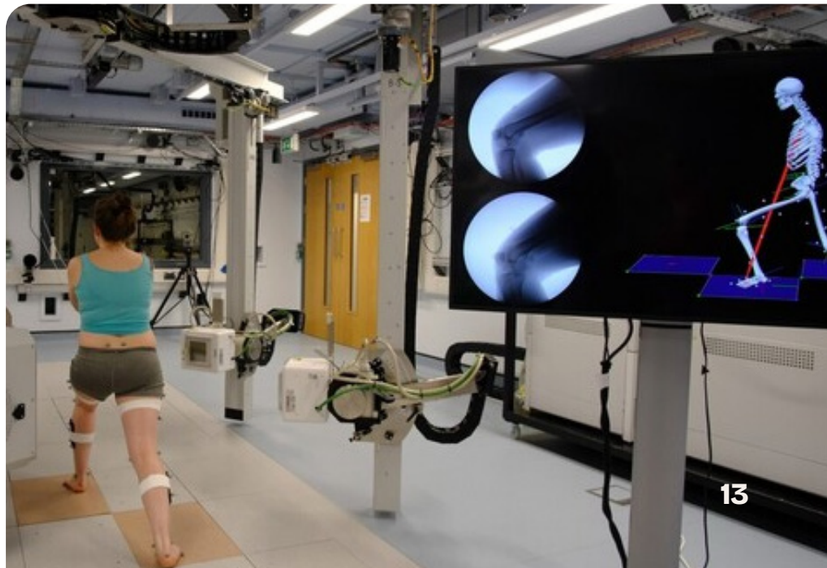
### Capacity building

This research facility is the only one of its kind in the UK. It houses a fluoroscopy laboratory with dynamic 3D X-ray capability. By combining these technologies, structures inside the body (such as joints) can be visualised in real-time like a film. Not only is this laboratory a one-of-a-kind in the UK, but it's also one of only a few worldwide.

### Influence on practice

These facilities enabled the establishment of Wales' first NHS Clinical Gait Analysis Referral Service in 2019. Before then, people living in Wales in need of this service had to travel to Oswestry in England.

**Quicker to get to your gait analysis referral**



## Motion captured, progress measured

**Rehabilitation sessions in the clinic commonly involve a physical examination during which patients perform a range of dynamic movements.**

However, it can be challenging for healthcare professionals to comprehensively assess multiple joints or limbs at once from these sessions alone. Which is why Centre researchers are exploring technologies that could be used to help provide timely, tailored support so that people can receive the right care and get back to normal faster.

For example, a 3D gait analysis tool, called the Cardiff Classifier, assesses the extent of biomechanical recovery following joint replacement. Centre research has tested this tool in many different scenarios to explore where it provides most value, demonstrating that:

- The Cardiff Classifier could help predict improvements in postoperative patient-reported activities of daily living, and overall gait function one year after total hip arthroplasty.
- The tool closely matches how people rate their own function after knee replacement surgery, meaning that it could be a useful tool for tracking progress.

Motion capture technologies have been used by Centre researchers to show that:

- Attaching small sensors to a person's back in combination with a computer model, called BACK-to-MOVE, accurately classifies non-specific low back pain. Developed by Dr Liba Sheeran, it could help make care more accurate, accessible and personal in the future.
- Inertial measurement units (IMUs), a system of sensors that measure movement and direction, are reliable for assessing movement patterns in the clinic. They also showed that this system can be correctly used by scientists with no experience in movement science. This is a promising finding for potential, widescale application in healthcare settings as IMUs are commercially available, easy to use and cost-effective.
- People with knee osteoarthritis use their lower leg muscles 30% less and hamstrings 25% more, resulting in a gait that increases pressure inside the knee which could lead to more joint damage.



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# Technology to tackle musculoskeletal pain

Self-management can greatly improve a person's physical health, leading to wide-reaching benefits across all areas of life. However, there are a lack of digital health interventions available to support the self-management of low back pain. Which is why Centre researchers have also been investigating tools which could encourage meaningful behaviour change and better patient engagement.

BACK-on-LINE™
*let us help you to help yourself*

## New intellectual property

BACK-on-LINE™ is a trademarked, personalised digital health tool to support the self-management of low back pain. It was developed by Dr Liba Sheeran in 2019 with Centre support. Since then, the tool has been deployed to hundreds of thousands of NHS and Transport for London workers, plus manufacturing sites in Sri Lanka.

## New networks

**Artificial intelligence** qualities within the BACK-on-LINE™ tool encouraged getUBetter, an NHS-approved self-management platform, to form a partnership. £750,000 has since been leveraged from the National Institute for Health and Care Research (NIHR) to integrate the two for testing.

# Liba's story

**"I'm an Associate Professor in Health Sciences at the University of Southampton and previously a Reader at Cardiff University. At the Centre, I began as Valerie's PhD student and eventually led a team developing self-management tools to support function and work participation, with a focus on low back pain."**

## What has Liba discovered?

"My expertise is in physiotherapy, musculoskeletal research and digital health, with a focus on personalising self-management to encourage meaningful behaviour change and better engagement. My team have developed **artificial intelligence** algorithms with clinicians using a unique dataset we have built through the Centre. These algorithms help tailor treatment to an individual's pain phenotype and personal needs.

We've compared this system against expert clinical opinion and showed it works. Clinicians have also helped us build and test it in real-life settings. The system is transparent in calculating how it works, and we've found this feature improves clinicians' confidence and understanding of it."

## What impactful research has Liba led on through the Centre?

"I led the development of BACK-on-LINE™, a digital personalised self-management tool designed to support people with low back pain, especially those in under-served working populations. My team have since partnered with getUBetter, a commercial NHS-approved digital health platform. Together, they are integrating the BACK-on-LINE™ classifier into the getUBetter platform. This collaboration attracted a £750,000 NIHR grant. The trial will test the getUBetter platform, incorporating our AI tool, in the rail industry to assess its application in real-world occupational health settings."

## What opportunities has the Centre created for researchers like Liba?

"The Centre gave me invaluable hands-on experience in working across disciplines, an essential skill in today's academic landscape. Its success lies in its interdisciplinary approach, diverse team and strong clinical infrastructure.

Thanks to the Centre's supportive culture, I now feel confident collaborating with experts from other fields, something that researchers may find quite daunting. It has played a key role in building my confidence and capability to work effectively with people who bring different perspectives and expertise."





# Cathy's story

**"I am a Professor of Biomechanics and Orthopaedic Engineering, Director of the Musculoskeletal Biomechanics Research Facility, and co-founder of the Centre."**

## How has Cathy's research helped to push forward the field?

"The discoveries we are making are building and improving tools to capture the measurements we want to make. With these tools, we can improve our understanding of how people with osteoarthritis move and potentially help improve their treatment in the future.

For example, we have gathered longitudinal information from people having high tibial osteotomy (HTO) surgery since 2010. Surgeons have performed HTO to help people with knee osteoarthritis since the early 2000s. However, it was only in 2020 that we combined our data with computer models to demonstrate that this surgery does work – it changes the knee loading how it is meant to. This reassures clinicians and patients that HTO is an effective surgery."

## What is Cathy working on next?

"We've recently been awarded funding to do more exciting research. One to combine motion capture with video X-ray and MRI, to build world-first and real-time recordings of how our joints, muscles and tissues interact during activities of daily living. And another with Imperial College London to investigate knee instability, a major cause for joint replacements to fail following knee replacement. We plan to build a pipeline of engineering tools that can help us understand why instability happens and design new implants that perform better. We might be able to use our findings to inform standards agencies and improve implant testing in the future."

## What has driven the successes coming out of the Centre?

"The quality and tenacity of our amazing academics and researchers who work across disciplines, which is very challenging. The Centre has trained physiotherapists and clinicians to do clinical research. Consistent funding from the Centre has allowed us to run longer studies on patients to record the patient journey, collect valuable samples, and develop tools that are being used by other researchers around the world."

# 03

# Unlocking new osteoarthritis causes and treatments

## Why is this important to people with arthritis?

**The way our joints are loaded influences our risk for developing osteoarthritis.**

However, it's unclear how abnormal movements or loads increase the risk of osteoarthritis developing and progressing over time. Centre research is exploring load-specific mechanisms underlying osteoarthritis using samples and models to find biomarkers and targets that could potentially treat, halt or prevent the disease.

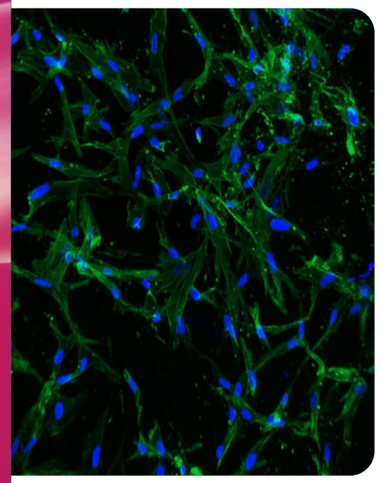




## Genes that explain why women feel more osteoarthritis pain

**To better understand the mechanical causes of osteoarthritis and test potential treatments safely, Centre researchers have developed models that mimic osteoarthritis using cells from bone, cartilage and nerves. These models complement the use of animal and human models.**

These models simulate human osteoarthritis-like conditions to understand what causes joint degeneration, pain and swelling, and ultimately causes osteoarthritis.



### New knowledge

From these models, Centre research has shown that mechanical loading:

- Regulates over 7,500 genes in bone associated with osteoarthritis-related pain, inflammation and degeneration.
- Regulates over 200 genes linked with nerve activity and growth.
- Regulates genes linked with pain in bone cells called osteocytes in women more so than men. This could help explain why women with osteoarthritis are twice as likely to experience pain than men.

### New networks

Industry partners are now using these Centre models to help study medicines to treat osteoarthritis in dogs.

### Leveraged funding

Centre models have leveraged grants exceeding £1 million from the National Centre for the Replacement, Refinement and Reduction of Animals in Research, Orthopaedics Research UK, Wellcome Trust and industry. The largest of these awards aims to develop an innovative 3D model that recreates interactions between bones and nerves, to investigate how pain and bone breakdown are linked in osteoarthritis. This could help speed up the discovery of new treatments, whilst also reducing the need for animal studies.

# Preventing osteoarthritis after injury

**A condition called post-traumatic osteoarthritis (PTOA) can develop after a traumatic joint injury such as anterior cruciate ligament injury.**

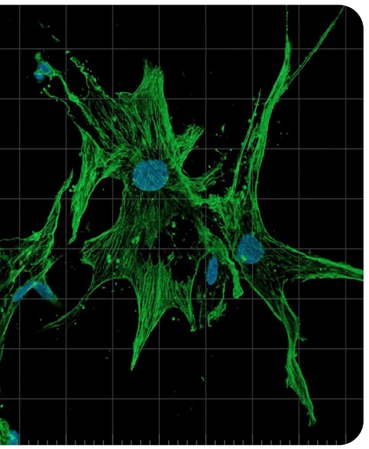
PTOA offers a unique opportunity to understand osteoarthritis, because the starting point of the condition is more defined than in general osteoarthritis (that is, it begins right after injury). This allows researchers to understand osteoarthritis in its earliest stages and track how the disease unfolds over time, expanding the window of opportunity to prevent or slow down its progression.

## New knowledge

Centre researchers learned that there are two broad stages that lead to PTOA developing: rapid inflammation that starts damaging joint tissue immediately, followed by long-term mechanical joint breakdown. Knowing this means that treatments can be identified, studied and targeted to the development stage of the condition.

- AMPA and kainate glutamate receptors, proteins found on the surface of joint cells and expressed in osteoarthritic joints, are a potential target to treat PTOA. When blocked in mice, swelling and joint damage was reduced by up to 45%.

## Drug target to treat PTOA



## Intellectual property

Patents for this potential target to treat PTOA have been granted in the US, Europe and China.

## New networks

Promising investigational medicines that use this approach are now being explored from this patent in collaboration with industry partners to treat PTOA. These medicines have been safely used in humans for other diseases and could be quickly repurposed for the prevention of osteoarthritis.

## Patient and public involvement

The trial methods that could be used to test these drugs are being shaped with lived experience, identifying their priorities and preferences to boost engagement with a future clinical study.



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# Damaging your joints disturbs the balance

As well as PTOA, joints can also experience other changes at the cellular level following mechanical overloading – changes that could reveal new treatment targets.

## New knowledge

Centre researchers have learned that mechanical overloading leads to:

01

**Imbalances in a cell communication system called Wnt, which typically helps tissues to grow, develop and repair normally.**

02

**Disorganisation in the cartilage cell cytoskeleton – a structure that plays a crucial role in maintaining healthy joints.**

03

**Miscommunication between the extracellular matrix and cartilage cells, causing structural damage and a spiralling feedback loop that accelerates damage in the joint.**

04

**Activated PKR and PERK pathways – a protein response system that is essential for maintaining joint integrity.**

# New knowledge

Nutrition plays a crucial role in so many aspects of our health. So perhaps it's no surprise that Centre researchers are also interested in potential links between joint heath and our diet. Two natural omega-3 fatty acids found in oily fish, called EPA and DHA, reduce **cartilage** breakdown induced by an inflammatory protein called IL-1β. Previous research had shown that EPA and DHA can reduce the expression of genes that damage **cartilage** at a molecular level, but this was the first study to show these effects occurring in **cartilage** tissue.

# New networks

With £1 million awarded by UK Research and Innovation, the OATech Network+ was established by Professor Cathy Holt. It ran from 2017 to 2022 and brought together world-leading osteoarthritis researchers across the UK to collaborate, identify knowledge gaps in the field, and publish papers that highlight important topics for future investigation.





# Deborah's story

**"I'm a molecular cell biologist and lead the pre-clinical research we conduct through the Centre. My main interest is in trying to understand the molecular causes of osteoarthritis to potentially develop new treatments in the future."**

## How has the Centre helped Deborah's research?

"Thanks to long-term funding provided by Centre, we have been able to collect thousands of samples with matched clinical and biomechanics data. Centre resource also enabled us to manage the complex ethics processes required to maintain and store these samples for years. These samples are incredibly valuable; they lay the foundation for all pre-clinical research we do at the Centre.

The Centre also allowed us to build a critical mass of researchers who speak the same 'language' across different disciplines. It has created a lasting legacy by funding fellows who are now lecturers, readers and highly successful independent researchers. Through the Centre, we also had access to a scientific advisory board who provided fantastic international expertise. This not only improved our science but opened the field internationally to collaborate with others and share our findings more widely."

## What has Deborah's research discovered?

"The most common cell type in our bones (called osteocytes), which orchestrate bone maintenance and repair, can be modelled to identify molecular drivers of osteoarthritis and test potential drugs. Before our research, osteocytes weren't considered a key player in osteoarthritis. It was an understudied cell type, and no model existed. We've developed an osteocyte model and used our advanced mechanical loading laboratory at the Centre to highlight their true importance. 7,500 genes in an osteocyte respond to a single mechanical stimulus, many of which relate to pain and joint disease.

We have tested a drug in development (called a glutamate receptor antagonist) in comparison with other drugs commonly used for injury, such as steroids and hyaluronic acid. We found that our drug was far more effective in reducing joint swelling, inflammation and degeneration in mice. This improvement is profound – if this drug was given twice, it could protect joint degeneration by up to 45%. A patent for this glutamate receptor antagonist has been granted, and we are now exploring it's potential to prevent osteoarthritis in both human and veterinary medicine."

# 04

# New networks and next generation

## Why is this important to people with arthritis?

**Understanding and applying advances in biomechanics and bioengineering to the real-world is vital to improve the lives of people with arthritis.**

By training a strong community of interdisciplinary researchers, harnessing lived experience insights, sharing knowledge, building influence and forming global connections across disciplines, the Centre is helping this important field to flourish now and into the future.



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## New skills and influence

**Training the next generation of researchers and experts is vital to lay the foundation for success in the future. By equipping emerging talent with new skills and knowledge, we lay the groundwork for life-changing breakthroughs.**

**More than**

**50**

**PhD students were supported through the centre.**

**5**

**clinical higher degrees were awarded to orthopaedic surgeons working in Wales.**

### Capacity building

Over 50 PhD students were supported through the Centre. One of whom was Dr Robert Letchford. Today, Robert is Consultant Physiotherapist in Musculoskeletal Rehabilitation at Cardiff and Vale University Health Board and Clinical Lead for the Musculoskeletal Health NHS Wales Performance and Improvement Strategic Clinical Network.

Through the Centre, clinical higher degrees were also awarded to five high profile orthopaedic surgeons working in Wales, including:

**Mr Andrew Metcalfe,**
who now serves on the NICE joint replacement guideline committee.

**Ms Alison Kinghorn,**
who is now a Consultant Trauma and Orthopaedic Surgeon at Hywel Dda Health Board, Wales.

### Mr Andrew Miller

“As an orthopaedic surgeon, the opportunity to interact with scientists at the Centre has been invaluable and hugely improved my understanding of the disease process behind osteoarthritis.”

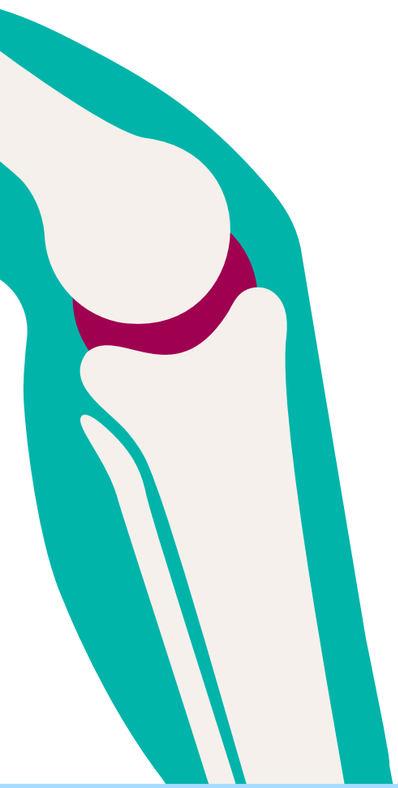
**Consultant Orthopaedic Surgeon.**

### Dr June Madete

“I am currently a Senior Lecturer at Kenyatta University, Kenya supporting a graduate education programme that prepares students to be Kenya’s next generation of inventors and entrepreneurs.

Skills that I have been able to transfer when I returned to Kenya were advising on clinical trials, patient communication, working as a team and grant writing.”

**Former Centre PhD student who specialised in motion analysis and lower limb biomechanics.**



In 2016, the Centre Director at that time, Professor Bruce Caterson, was awarded the Lifetime Achievement Award from the International Combined Orthopaedic Research Societies for his longstanding contributions to orthopaedic research.

### Capacity building

Centre funding facilitated the start of orthopaedic research at the Cardiff and Vale Orthopaedic Centre at Llandough Hospital, Cardiff and Vale University Health Board. The site is now the leading NHS centre of its kind in Wales. The surgical team there carries out more than 10,000 operations a year.

### New networks

Centre researchers have run over 30 public outreach events to connect with people with arthritis. They also ran a roadshow in Autumn 2024 which toured Rhos on Sea, Wrexham, Cardiff, Carmarthen and Aberystwyth, to shape and share the breadth of Centre research and its impact with physiotherapists and the public.

## Roadshow map

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# Meaningful involvement

**At one engagement event hosted by the Centre for people with arthritis:**

**100%**

**of respondents agreed that they felt their attendance had made a difference to future arthritis research at Cardiff University.**

**96%**

**agreed that their knowledge or understanding towards arthritis research had changed after the event.**

**“Without research and patient feedback, we are not going to be able to increase our knowledge of arthritis, diagnosis, treatment and possible future orthopaedic treatments. Ultimately this would be detrimental for patients who are struggling with and require care for this debilitating disease.**

**David Ogden, patient partner.**

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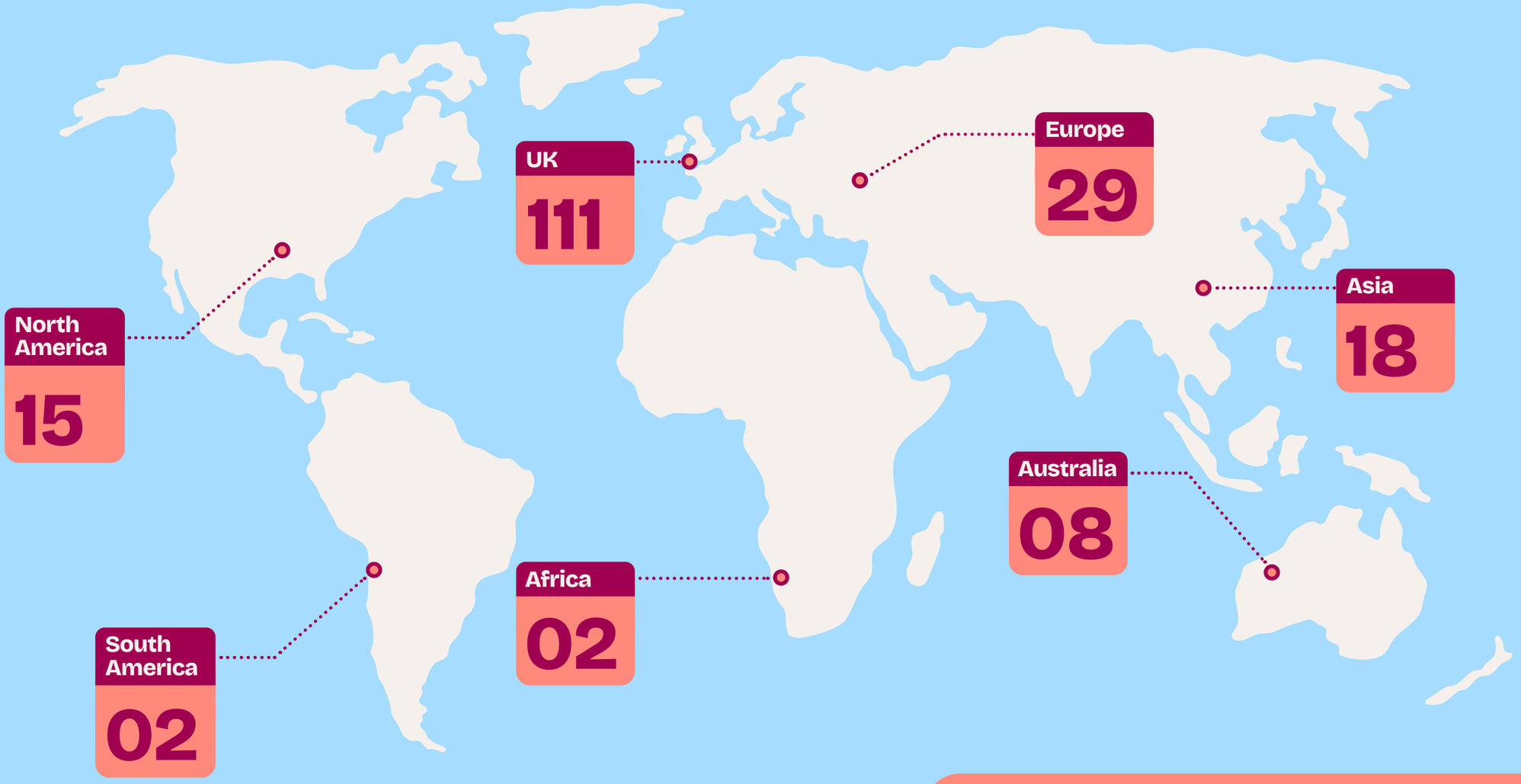


# Research reach

The Centre has **185** global collaborators

Spanning **health, industry and academia**

across **28** countries.

# Glossary

## Anterior cruciate ligament (ACL)

Band of tissue inside the knee that connects our thigh to our shin. It helps stabilise our knee when we turn, twist or suddenly stop.

## Artificial intelligence (AI)

Computer system able to perform tasks that typically require human intelligence (such as learning, decision-making or problem-solving).

## Cartilage

Smooth cushioning substance covering the ends of bones.

## Cytoskeleton

A cell's internal skeleton that keeps its shape and function.

## Early-stage osteoarthritis

Beginning phase of osteoarthritis, where the breakdown of cartilage in joints is minimal.

## Extracellular matrix

Proteins, carbohydrates and minerals that encase the cells and provide structure to the tissues.

## Fluoroscopy

Non-invasive medical imaging technique that creates a real-time video inside the body.

## Gait

The way a person walks.

## High tibial osteotomy (HTO)

Surgical procedure that treats early-stage osteoarthritis in the knee by correcting misaligned bones in the femur and shin.

## Hip arthroplasty

Hip replacement surgery.

## Inertial Measurement Units (IMUs)

A system of sensors that measure movement and direction.



Helpline 0800 5200 520

## Late-stage osteoarthritis

Advanced phase of osteoarthritis where there are substantial bone changes and cartilage breakdown.

## Mechanical loading

How weight and pressure spreads through our bones and joints as we move.

## Osteocyte

The most common bone cell that controls bone responses to mechanical load.

## Phenotype (of a disease)

How a disease appears or behaves in different people.

## Post-traumatic osteoarthritis (PTOA)

A form of osteoarthritis that arises from a joint injury.

## Total knee replacement (TKR)

Surgical procedure to treat late-stage osteoarthritis that involves replacing damaged bone and cartilage with an implant. It is also known as total joint arthroplasty (TJA).

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