Arthritis UK

Tissue Engineering and Regenerative Therapies Centre

Impact Report

Renewing joints with osteoarthritis through research

Osteoarthritis is a joint disease that can lead to pain, swelling and restricted movement. Before we opened our Tissue Engineering and Regenerative Therapies Centre, it wasn't understood where the condition started or which parts of our joints, damaged by osteoarthritis, show potential for repair in the early stages. Early-stage osteoarthritis therapies were focussed on managing symptoms like pain rather than treating the condition itself. This meant there was a need to bring osteoarthritis specialists together, combining their expertise and ideas to engineer new therapies that could tackle the condition.

Helpline 0800 5200 520

Enter the Tissue Engineering and Regenerative Therapies Centre

The Universities of Newcastle, Aberdeen, York and Keele teamed up with the Robert Jones and Agnes Hunt Orthopaedic Hospital when the Centre first launched in 2011. Now, it also spans world-class facilities across the Universities of Cambridge, Birmingham and Edinburgh. Researchers across these groups aim to develop new treatments and strategies, ahead of a joint replacement, that may have a role in slowing or preventing the development of early-stage osteoarthritis.

Under the leadership of Professor Andrew McCaskie, the Centre has received £4.6 million of infrastructure funding from Arthritis UK. This has supported the creation of a network, which has allowed us to build capacity to ask and address fundamental and impactful questions, informed by the patient and public community.

Arthritis UK | Tissue Engineering and Regenerative Therapies Centre

Right person, right time, right treatment: the stratified future of osteoarthritis care.

As a surgeon interested in research, I have, over many years, looked to contribute to new treatment development, particularly in osteoarthritis, where there are around 10 million people affected in the UK alone.

When it comes to treatment, we often imagine a completely worn and destroyed joint, which causes significant pain and limited function. For this type of end-stage disease, we have developed an excellent treatment in the form of joint replacement, with hip replacement described in the 1990s as the ‘operation of the century’.

But what about earlier stages of disease in younger people? This question inspired the creation of the Arthritis UK Tissue Engineering and Regenerative Therapies Centre in 2011, bringing together a group of researchers from different disciplines and locations across the UK.

Osteoarthritis has many different subtypes, with different triggers that can act at an early stage, and it has been proposed that there is a ‘window of opportunity’ to treat at this earlier stage. But to do this we need to understand the subtypes and triggers in order to stratify our treatments.

The new treatments that we consider range from targeting the body’s own potential for repair to giving a cell as an actual therapy.

We have throughout used a translational or a ‘bench to bedside’ approach to research, gaining a detailed understanding using modern powerful scientific techniques now available to us.

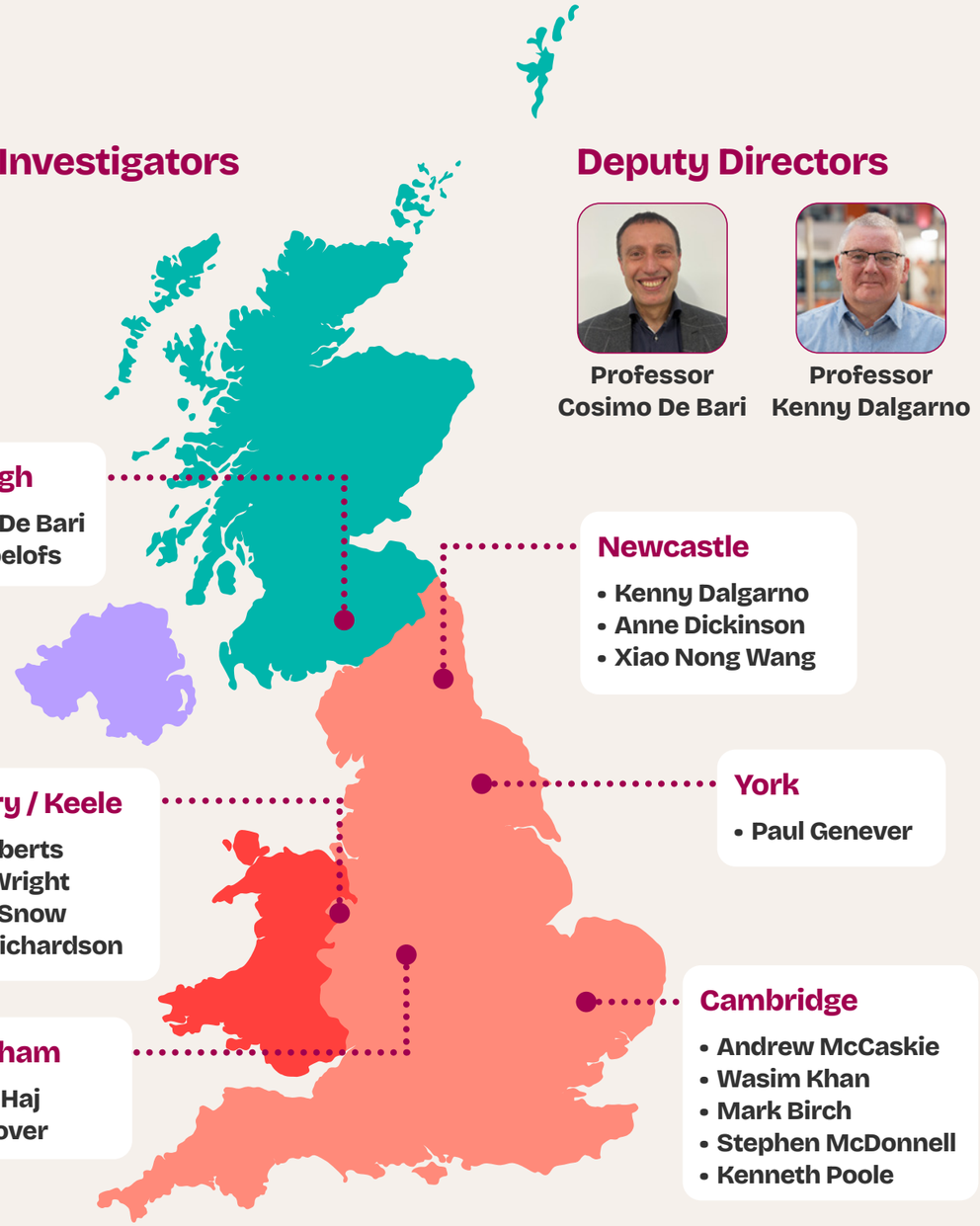
This has allowed us to understand important aspects of joint formation and joint disease at the molecular level. We have been able to develop new types of MRI imaging techniques, where an individualised cartilage map can be created for a patient. Work at Oswestry over many years aimed to understand and develop cartilage cell therapy to repair early cartilage damage. This contributed to the evidence for it to be approved by NICE and adopted by the NHS. We have gained insights into the bioprinting of cells and cell signalling with extracellular vesicles. More recently we have been working on stratification of patients, working with artificial intelligence, we used machine learning to identify a sub-group of patients with a rapid rate of osteoarthritis progression compared to other patients.

These types of research contribute to patient matching to treatment. Such stratification and grouping of people based on specific characteristics is very important, so that the right patient gets the right treatment at the right time.

Professor Andrew McCaskie,
Centre Director

Helpline 0800 5200 520

Centre Investigators



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The Arthritis UK Tissue Engineering and Regenerative Therapies Centre is investigating ways to:

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Engineer ways to restore our joints

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Deliver solutions to patients

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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

£4.6m of Arthritis UK funding has led to:

More than **250** publications cited more than 8,000 times.

More than **£50m** leveraged funding.

More than **140** staff and students employed and trained.

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Research achievements at the Tissue Engineering and Regenerative Therapies Centre

2011

Alan Shearer launches the Tissue Engineering and Regenerative Therapies Centre, funded by Arthritis UK.

2012

Centre establishes a UK-wide training and peer-support network for PhD students and early-career scientists, doctors, and engineers specialising in the field of regenerative orthopaedics.

2015

Centre research identifies bone marrow stem cell lines with specific roles and functions. These cell lines are now used as a tool worldwide in osteoarthritis research.

2017

Cells typically present in the joint are shown to be able to repair damaged cartilage. Targeting these cells can promote the body's own ability to repair cartilage.

2017

Cartilage cell therapy called autologous chondrocyte implantation (ACI, brought over to the UK from Sweden by Centre researchers) is recommended by NICE for use in the NHS. The NICE committee state, "the consensus among UK clinicians is that this is the only effective treatment option for larger cartilage defects in the knee when symptoms persist after non-surgical management".

2019

Reactive jet impingement, a 3D-bioprinting system used in osteoarthritis research within the Centre is patented.

2020

Research conducted in collaboration with the Arthritis UK Centre for Osteoarthritis Pathogenesis shows that a protein called agrin stimulates joint cells to repair damaged cartilage. Agrin is now being commercially developed into a new treatment for osteoarthritis.

2020

Centre researchers discover that joint stem cells, previously shown to repair damaged cartilage, can also form bony outgrowths at the edges of osteoarthritis joints. This highlights the importance of understanding how to control the activity of these cells to promote correct repair.

2020

Medical Research Council invests £2.7 million in the development of an 'off-the-shelf' version of ACI. This will lower the cost of manufacture and delivery of the treatment so that more patients can access the service on the NHS.

2021

Stem cells from umbilical cords are found by Centre researchers to enhance cartilage repair, supporting the potential use of these cells as an easier and more cost-effective form of cell therapy.

2023

The Cambridge Movement Surgical Hub was established to make orthopaedic care more efficient and lessen the waiting list backlog.

2023

Last patient treated in a landmark clinical trial called ASCOT – the first to compare standard ACI with a stem cell therapy, either alone or in combination with chondrocytes.

2023

Spin-out company Mesenbio founded to develop cell particle-based therapies.

2024

Centre researchers demonstrate they can recruit people with early-stage osteoarthritis to test a new type of MRI scanner for detecting osteoarthritis early. This led to a large follow-on study funded by Arthritis UK called PIOKNEER.

2025

Artificial intelligence and machine learning approaches used to successfully stratify patients by identifying early patients in whom osteoarthritis will progress rapidly.

2025

The Cambridge Movement Surgical Hub introduces ACI to region and attains accreditation by NHS England as a surgical hub.

2026

Development and progression of more than 60 PhD students. Many have gone onto prestigious careers including Arthritis UK Fellowships and international Professorships.

The future

01

Understanding the osteoarthritis journey

Why is this important to people with arthritis?

It's important to understand how the cells of our joints change when osteoarthritis first occurs so that it can be identified early and stopped in its tracks. Knowing the earliest signs of disease provides a clearer window of opportunity for treatment, preventing or stopping osteoarthritis from getting worse.

Spotting the signs early

Osteoarthritis isn't the same for everyone – there are many causes including a person's genetics, metabolism, age and previous joint trauma history. All of this can lead to the condition's presentation. This is partly why it's challenging to treat osteoarthritis effectively. Centre research is helping us to understand the different ways that osteoarthritis presents itself to help us identify, predict and treat it early. For example, the Centre has:

- Found two new subgroups (phenotypes) of osteoarthritis, by comparing cartilage and synovium cells to find differences in the way they behave at a molecular level. Each subgroup may respond to treatment differently, meaning that it could help future approaches for personalising treatment.

- Predicted which individuals with knee osteoarthritis are at risk of rapid progression, especially in early stages of disease and among younger people, using a machine learning tool. This tool could help identify at-risk people so that they can receive optimised care earlier and live the life they want.

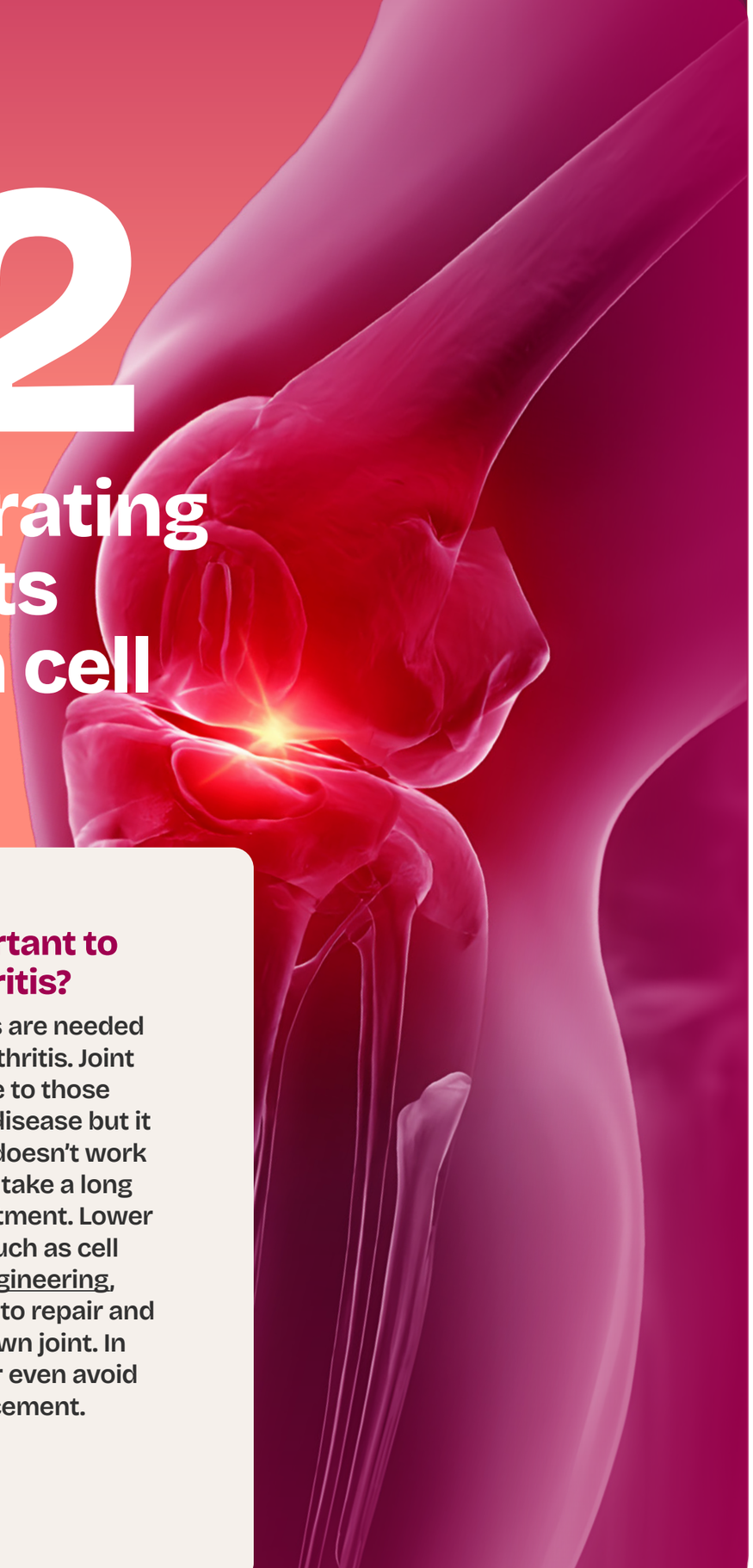
- Found a target that could be used to develop a first-of-its-kind disease-modifying therapy. Osteoarthritis is currently managed by treating symptoms through lifestyle changes, anti-inflammatory drugs, or surgery. This promising target is a process used by cells for communicating to each other using proteins called bone morphogenetic proteins (BMPs).

"I was invited to join the Centre Scientific Advisory Board from February 2019 until June 2022 to improve Patient and Public Involvement (PPI) in musculoskeletal (MSK) research. This invitation stemmed from my participation in PPI work on the Biomedical Campus and my personal experience of an unsatisfactory osteoarthritis treatment pathway… Major challenges remain in educating healthcare systems to employ patient-centred diagnosis and early application of continuing osteoarthritis research, ultimately leading to MSK disease prevention.

Barbara Dorban-Hall
PPI Group Member

02

Regenerating our joints through cell power



Why is this important to people with arthritis?

More treatment options are needed for people with osteoarthritis. Joint replacement is available to those with severe, late-stage disease but it is a major surgery that doesn't work for everyone, and it can take a long time to access this treatment. Lower intensity alternatives, such as cell therapies and tissue engineering, are promising methods to repair and regenerate a person's own joint. In fact, they could delay or even avoid the need for joint replacement.

Helpline 0800 5200 520

Cell power now on the NHS

Centre research is investigating whether our own cartilage cells, or those from other people, can be used to repair damage caused by arthritis. Their work helped drive the approval of a surgical therapy called autologous chondrocyte implantation (ACI) for the treatment of knee cartilage defects by the NHS in 2017. ACI was first performed in 1987 in Sweden but Centre research brought it to England. It was the first cell therapy available on the NHS for treating cartilage defects in the knee. These defects when left untreated can develop into osteoarthritis. Today ACI is commercially available across multiple continents, helping tens of thousands of people to date globally.

ACI works for the majority of those eligible for it, and in some is effective for decades. However, ACI doesn't work for everyone. ACI leads to no improvement of symptoms for roughly one in five cases. These people will probably need joint replacement later on. To find out where your nearest centre offering ACI is, please ask your orthopaedic surgeon.

What is ACI?

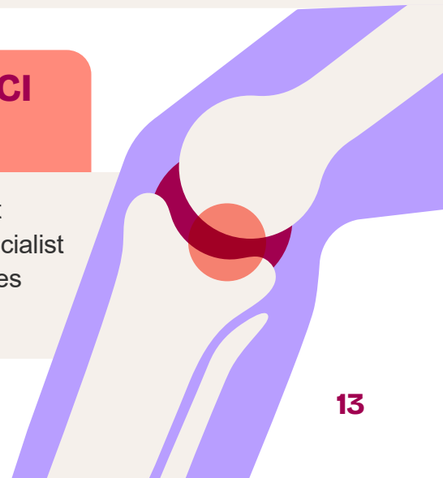
A type of cell therapy for people with early knee cartilage defects. It involves removing a small sample of cartilage from an individual's joints. This tissue is then used to grow a fresh supply of cartilage cells in a laboratory. These cells are later implanted into the damaged area of the joint in another operation, after which they form new cartilage to aid repair.

Who is ACI for?

The ideal patient is a physically active adult aged 50 or younger with a single cartilage defect (hole in the cartilage) larger than $2cm^2$ (roughly the size of a fingernail or shirt button). It is not recommended for people with widespread or advanced osteoarthritis.

Where is ACI available?

ACI is available at fewer than 10 specialist orthopaedic centres across the UK.



Maximising benefits from ACI

To maximise the success of ACI and avoid this costly surgery for the one-in-five cases it won't benefit, Centre researchers are identifying those who will benefit from it the most:

- The ORKA-1 tool was developed with Centre members to predict success of ACI surgery based on age, gender and pre-surgery characteristics in the affected joint. This tool is now used by surgeons and patients in specialist orthopaedic centres to help decide who will benefit from ACI surgery.
- Additional factors have been found to help better predict outcome to ACI before treatment. Such factors range from biomarkers in our blood and synovial fluid to joint characteristics.

The power of our own body to heal itself

Stem cells are an important part of the body's repair kit because they can make copies of themselves and turn into any type of cell. They can be found in various tissues including our bone marrow and joint tissues. However, in people with osteoarthritis, joint stem cells may become less effective at repairing cartilage. This is why Centre researchers are studying several types of cells and environments, to find out what works best to grow cells with the potential to heal and repair cartilage in early-stage osteoarthritis.

Arthritis UK contributed over £500,000 to the ASCOT study which is comparing different cell therapies. Following this:

Cambridge University leveraged nearly €1 million from the European Commission to support two cell therapy studies in osteoarthritis called ADIPOA2 and STARSTEM.

Two patents and a spin-out company have been created based on a novel method to produce and use extracellular vesicles for promoting tissue repair. The company, called Mesenbio, formed following £1.4 million funding from two external investors and an Innovate UK Biomedical Catalyst grant.

Researchers showed that bony spurs visible in X-rays called osteophytes, which can cause pain and stiffness in osteoarthritis, are formed by specific stem cells. These stem cells in the joint present a potential new target to treat osteoarthritis.

Creating the best environment for ACI

Centre researchers have explored multiple ways to help these cell types perform as well as they can to heal our joints, including by:

Culturing cartilage cells in **2% oxygen,** which improves their ability to grow compared to when they're exposed to normal air (which holds 21% oxygen).

Mechanically stimulating stem cells to increase the capacity of these cells to make new bone tissue.

Treating stem cells with a gel made of **fibrin**, a protein involved in our natural blood clotting process. This accelerates cartilage repair and growth.

How do we know what works?

Centre researchers have found a new way to track cells, by tagging them with magnetic particles called SPIONS. SPIONS show up in an MRI image and because of this, they can be used to measure how well a delivered cell therapy heals cartilage in the joint.

YAP: The balancing act between joint repair and inflammation

In 2001, researchers now linked to the Centre were involved in discovering the presence of stem cells in the synovium of adults. Since then, the field of research exploring how these cells can help repair our joints has grown and attracted interest around the world. These Centre researchers have more recently found that:

- A molecule called YAP helps regulate the function of stem cells present in the joint. Fine-tuning YAP activity could help maintain the health of our joints.
- Too much of this YAP protein, and the pathways that control its activity, fuel joint damage. They make certain joint cells in rheumatoid arthritis become more aggressive and inflammatory. That means that fine-tuning YAP could also be a promising way to treat rheumatoid arthritis.

Sally's story

"I'm an Emeritus Professor at Keele University and have been a part of the Centre since it began in 2011. I completed my PhD at the Robert Jones and Agnes Hunt Orthopaedic Hospital (RJAH) in Oswestry where I studied the molecules that make up cartilage and the intervertebral disc. This includes collagen, the main protein in our musculoskeletal system. Back then, in the 1980s, we thought there were only two or three types of collagen in our body. Now, we know there's 28 different types – the field has progressed massively."

How did Sally get started in the field of cell therapies?

"The RJAH is a relatively small hospital but it's very busy and a great place to do arthritis research – you can work closely with surgeons. It also enables access to human waste tissue soon after removal from the body. A cell manufacturing facility opened at RJAH in the 1990s. This was used to grow patients' own cells which were then used to treat cartilage defects in their knee, via a process called ACI.

The samples and clinical connections that I and the team here in Oswestry gained during that time laid the foundation for Centre research happening today. For example, with Centre funding over many years we maintained long-term datasets on ACI patients that have been used to investigate many different things, like identifying factors and biomarkers that can help predict which patients will do best with this treatment."

What are some of the major successes from the Centre?

"Long-term ACI data from RJAH, pioneered by Professor James Richardson, was used as evidence for ACI to be approved by NICE in 2017. Because of this, ACI is now available through the NHS for some people with early-stage osteoarthritis in certain hospitals in the UK, including Cambridge and RJAH.

By applying predictive modelling on our long-term ACI dataset, we also built a tool called ORKA-1. ORKA-1 is used today by orthopaedic surgeons and patients to predict how long ACI will last for an individual before they will need a knee replacement, enabling shared decision-making."

Where does Sally think the cell therapy field will travel next?

"ACI uses autologous cells, an expensive and complex process which is stifling its potential. Looking forwards, we need to try something different. That is why we're exploring an alternative approach using allogeneic cells, through a study called ACT2 until 2029, with a £2.7 million grant from the Medical Research Council (MRC). In the next 10 years, I hope we can move towards cell therapy being delivered more simply and quickly, as an injection, and for any type of joint."

Cosimo's story

"I'm a Professor of Rheumatology at the University of Edinburgh and a Deputy Director of the Centre. The Centre started when I was previously based at the University of Aberdeen."

What does Cosimo investigate through the Centre?

"We focus on trying to understand what makes a joint healthy, and the ability of our joint tissues to regenerate. To do this, we study questions like 'how can we recognise when joints are healthy?', 'how can we spot disease?' and 'how can we treat the disease at an early stage to slow down, halt or even reverse joint damage?'

For many years, researchers have studied arthritis at advanced stages, when it becomes difficult for joints to repair and joint replacement is often the only solution. There are lots of unanswered questions about osteoarthritis in its early stages. This gap in research and understanding leads to a gap in care delivery. We still do not understand some of the more basic aspects of how joints work, or what goes wrong especially in the earliest stages of osteoarthritis before the disease can be spotted on an X-ray.

With our collaborators at the University of Aberdeen, we are now testing whether a new type of MRI scanner can detect knee osteoarthritis at an early stage, before changes become visible on an X-ray. This could help to diagnose disease earlier and test new treatments at the early stage of disease."

What are some of Cosimo's key discoveries through the Centre?

"Discovering that stem and progenitor cells have the power to repair joint tissues. These are a group of cells within our joints, and we identified a subset of these cells that can repair cartilage. We have studied these cells in joints with osteoarthritis. We've found that whilst these cells try to repair tissues, they can go a step too far and form bony spurs called osteophytes, commonly found in people with osteoarthritis.

We've also shown that a molecule called YAP is important for cells in our joints to become activated and repair cartilage after injury. However, too much of this molecule leads to the cells becoming destructive. Understanding how misbalances such as these can cause arthritis is vital as it can lead to treatments that can fine-tune such balances and potentially prevent disease. We're building models now to study this delicate balance between repair and disease further."

How has being a part of the Centre helped Cosimo?

"The Centre has provided the infrastructure to build collaborations and a stable research environment from which we can try to answer bigger questions. The Centre has also supported junior colleagues to progress into prestigious roles around the UK and world. Arthritis UK branding has enhanced the visibility of the Centre and its investigators."

03

Engineering ways to restore our joints

Why is this important to people with arthritis?

A treatment gap exists for young active adults with osteoarthritis, especially those aged 50 and under. Joint replacement is unsuitable for these people because it can lead to multiple, costly and complex revision surgeries associated with lengthy hospital stay and rehabilitation. Alternatives are urgently needed, and so the Centre is studying different tissue engineering approaches to discover ways to restore our joints without a joint replacement.

Helpline 0800 5200 520

Joints of the future

Centre researchers are exploring many tissue engineering strategies of the future, including different materials and 3D-printed structures. These provide support, strength and repair-promoting chemicals for joints with osteoarthritis to grow on and rebuild themselves.

These materials can be mixed in different ways and combined with different types of cells to create customised structures that help our joints heal better inside the body. The Centre's wide expertise in this field is helping shape the next generation of researchers; its team has written several chapters of textbooks that are used across the scientific community.

Hydrogel

Bioglass

Polymer blends

3D-printed multi-material scaffolds

Accelerating the hunt for new treatments against arthritis

To find therapies that are safe and effective, they must be tested under realistic conditions. Lab-made models and tissue structures are an important tool in these essential, early steps of the testing pathway because they can recreate the natural environment outside of humans. That's why Centre researchers are developing such models and structures, helping reduce the amount of time it takes for therapies to reach patients.

Model for success

A Newcastle spin-out company called Jetbio was established by Centre researchers to commercialise a droplet-based 3D bioprinting system called reactive jet impingement. This system can create tissue structures efficiently and at scale, meaning that therapies can be screened more quickly.

Arthritis UK Fellow Dr Timothy Hopkins, with Centre support, led research that showed a healthy human synovium can be replicated by an organ-on-a-chip model built on a commercially available platform. This model will enable new targets and therapeutics against osteoarthritis, including disease-modifying therapies, to be identified and tested on scale in a controlled way before being studied in humans.

Paul's story

"I'm a cell biologist and Centre research lead for the University of York."

What has Paul found through the Centre?

"I focus on stem cell research to find new cell-based therapies for treating arthritis. Cells within our bone marrow are frequently used in clinical trials but we've found that not all of them really are stem cells. They're a mix of different cells with a huge diversity. True stem cells can make new cartilage or bone, a valuable power for treating people with arthritis, so my work is focused on finding them. You wouldn't mix paracetamol with a range of unknown chemicals to treat pain; you would just give paracetamol. The idea is similar here.

We did this by extracting all the cells from a donor's bone marrow and 'immortalising' them – we gave them an enzyme they don't usually have to make them live forever. This meant we could do multiple, long-term experiments to play with each single cell and multiply them to make colonies. From these colonies we analysed the properties of each cell and eventually found one called Y201 that had all the most powerful attributes to regenerate cartilage. It's a true stem cell."

How has Arthritis UK supported Paul and his research?

"Funding from Arthritis UK has been absolutely fundamental. The charity gave me my first Fellowship in the early 2000s which then set me on a path to later join the Centre. This is where I cemented my career as a lecturer, and where I trained a PhD student called Dr David Kuntin. Together, we co-founded a spin out company called Mesenbio underpinned by research funded by Arthritis UK. Mesenbio aims to commercialise a therapeutic platform using extracellular vesicles, tiny fragments of cells that help cells communicate with one another. It took years and years to make our scientific breakthroughs and find Y201 – there were many rabbit holes and dead-ends along the way. This is why financial continuity from a Centre model is so vital. Since then, we've won funding from Innovate UK and external investors to drive Mesenbio closer to the clinic. Next, we're exploring how our platform can be used to treat other conditions with industry partners, such as a drug screening tool."

Where does Paul hope his research will travel in the next 10 years?

"I hope that our extracellular vesicle therapeutic will have finished human trials and be close to real-world use in the clinic. I also hope we will have a more standardised approach to explore and authorise therapies for arthritis. There are so many clinical trials happening now involving stem cells, but they are being performed in so many ways which is hampering progress."

Kenny's story

"I'm a Professor of Manufacturing Engineering at Newcastle University and Deputy Director of the Centre. I study different biomaterials that can support our tissues to repair and function like normal – a process that is typically disrupted in osteoarthritis. I also investigate technologies that fine-tune and maximise how biomaterials are made and how they are delivered. By making biomaterials better and at scale, we hope to help treat more people with osteoarthritis as well as possible."

JETBIO

What has Kenny achieved through the Centre?

"I co-founded Jetbio, a spin-out company from Newcastle University that commercialises our patented bioprinting technology known as reactive jet impingement. Early research into reactive jet impingement was supported through the Centre. Reactive jet impingement is a way of creating cell cultures in gel-like materials. It produces human-like tissue, allowing us to model how well a therapy works rapidly so that we speed up the current lengthy process for developing drugs and getting them to patients. Reactive jet impingement is a technology that can be used for many different diseases like cancer."

What is Kenny studying next?

"Next, we're working on improving in vitro models so that we can better evaluate new therapies for osteoarthritis. By combining bioprinting technology with other materials immediately prior to implanting it into the patient, we have more control over where the cells go in and where they implant. We're also demonstrating that **it could be possible to use this bioprinter in clinical environments, meaning that patients could see their implants printed before their eyes!**"

04

Delivering solutions to patients

Why is this important to people with arthritis?

Centre research is helping to maximise benefits for people with arthritis now and in the future by building capacity and capability through new research, facilities and technology, and empowering the next generation of researchers.

Scaling up

ACI therapy currently involves using a patient's own cartilage cells, known as autologous chondrocytes, and the process involves two stages. It's complex, expensive and carries regulatory constraints, which slows wide-scale NHS adoption. To solve this, Centre researchers are exploring alternative products with fewer restraints. They have shown that 'off the shelf' cartilage cells, known as allogeneic chondrocytes, could be manufactured on scale instead. It's a promising alternative for treating early-stage osteoarthritis that could streamline NHS adoption of cell therapy.

On the back of this finding, Centre members were awarded a multimillion pound grant from MRC for a project called ACT2 to run a clinical trial. ACT2 aims to optimise the manufacturing process of allogeneic chondrocytes with the hope that it could be adopted by the NHS in the future.

New surgery theatres

The Cambridge Movement Surgical Hub was developed in partnership with Cambridge University Hospitals, NHS England and Getting It Right First Time (GIRFT) – a national initiative run by NHS England. The hub was designed to make orthopaedic care for patients more efficient with 40 hospital beds and 3 state-of-the-art operating theatres. It opened in 2023 to tackle the waiting list backlog for joint replacements and reduce length of stay. It was accredited as a surgical hub in 2025. ACI procedures are now taking place there.

World first machine

Centre Co-Director, Cosimo De Bari, and colleagues at the University of Aberdeen, leveraged £1.2 million from Arthritis UK for a study called PIOKNEER, which will use the world's first clinical grade Field Cycling Imager (FCI) to:

- Explore its potential to detect early-stage knee osteoarthritis before changes are visible on x-ray;
- Monitor disease progression over time. This could help assess how well a treatment works in future studies.

Next generation

More than

60

PhD students have been supported through the Centre.

Karina's story

"I'm a Professor in Orthopaedics and Tissue Engineering based at Keele University. My laboratory group is based at the RJAH Orthopaedic Hospital in Oswestry."

What research does Karina focus on?

"Firstly, my team biologically profiles patients at different stages of osteoarthritis, exploring what their tissues look like before and after treatment to understand and potentially predict who does and does not benefit from treatment, and why.

Secondly, I investigate new ways to improve how cellular therapies for knee injuries at risk of osteoarthritis in the future, such as ACI, are manufactured and delivered. This surgical procedure was first performed about 30 years ago and since then, the way it is delivered has not changed much. This is why exploring alternative cell sources to try and improve the technique and maximise its success for patients. On top of this, we're identifying joint fluid markers that correlate with how well someone's joint heals after cell therapy. Finding these markers could help us better match cell therapy to the right patient."

What has this led to?

"Through the ASCOT study, funded by Arthritis UK and supported through the Centre, we have been able to leverage lots of additional funding. For example, Arthritis UK has directly funded a PhD studentship to support the study. The charity has also recently awarded us £200,000 to help bring this alternative 'off-the-shelf' cell therapy closer to market. For this, we will be studying what characteristics produce top-performing cells so that we can deliver consistent results to effectively treat people with early osteoarthritis at scale."

How has being a part of the Centre helped Karina?

"The multidisciplinary team at the Centre all investigate slightly different things but very complementary areas of science and medicine. Linking with these different collaborators has been invaluable to help me shape my research, build my career, and gain access to laboratories with specialist techniques and samples. We hope that what we're learning can be applied to improve and widen the opportunity to heal joints in people with osteoarthritis and potentially develop new therapies."

Simone's story

"I'm a PhD student at Trinity College in Cambridge and an orthopaedic surgeon. One of my supervisors is Professor Andrew McCaskie, the Centre Director. I joined the Centre through the Department of Surgery at the University of Cambridge. I chose this department knowing that through the Centre, I could collaborate with world-leading clinicians, scientists and engineers all in the same space."

Why is Simone's research needed?

"Orthopaedic surgeons are generally very good at treating end-stage osteoarthritis with joint replacements. However, we have very few treatments for the early stages of disease, especially in younger patients, where there could be a window of opportunity to intervene using regenerative therapies. The key challenge is that osteoarthritis is varied and unpredictable. We simply don't know who will get worse and how quickly the disease will worsen. My core area of research is using advanced machine learning to predict the rapid progression of osteoarthritis. We've done exactly that by validating a model which works very well in patients in the early stages of disease. It provides a prediction which can be visualised using a web-based application allowing clinicians to interpret its results more easily."

What is Simone working on next?

"Next, we're improving our machine learning models to make them more accurate and precise so that they can work for more people with osteoarthritis. Traditional data sets are often biased, for example towards certain ethnicities, and can have an underrepresentation of certain groups, such as patients in the early stages of disease. To reduce these biases, we are incorporating other data into our models to improve them, including computer-generated datasets. A one-size-fits-all approach to treating arthritis won't work because the impact it has on a person is unique. This is why it's so important to develop precision health tools like ours.

The Centre is a very collaborative environment and so, on the back of this work Professor McCaskie and I plan to combine our machine-learning model with movement data using wearable sensors. This clinical study will be my first and is called AMALGAM. It is supported through the Institute of Metabolic Science (IMS) Epidemiology."

Glossary

Allogeneic chondrocytes

Cartilage cells derived from a different person.

Autologous chondrocytes

Cartilage cells derived from a person's own body.

Autologous chondrocyte implantation (ACI)

Surgical procedure where a small sample of a person's own cartilage tissue is taken, grown in a lab, and then implanted back into the damaged area of their joint to help repair it.

Bioglass

Special type of glass that can bond with bone and help it repair and grow.

Biomarker

Measurable sign in your body that can be used to identify whether a person has a particular condition or not.

Bioprinting

3D printing technology that uses living cells. It can be used to create products similar to human tissue.

Cell therapy

Type of treatment where living cells are put into a person's body to heal damaged tissue or treat disease.

Chondrocytes

Cells that make and maintain cartilage.

Clinical trial (or clinical study)

Type of research study involving humans.

Disease-modifying therapy

A treatment that not only relieves symptoms, but also slows or alters the course of a disease.

Extracellular vesicle

Bubble-like delivery packages (released by cells) that carry important materials, enabling cells to communicate with one another.

Hydrogel

Jelly-like material that can be placed into damaged joints to support cartilage repair, deliver healing cells or medicines, and help protect and cushion the joint as it heals.

Intervertebral disc

Cushion-like structure that sits between the bones in our spine allowing movement and absorbing forces.

Helpline 0800 5200 520

Knee cartilage defects

An isolated, localised area of damaged cartilage with healthy surrounding tissue, often caused by trauma.

Mesenchymal stem cell

Type of stem cell often found in bone marrow.

Osteophyte

Bony outgrowths that can develop in people with osteoarthritis and are associated with pain and stiffness.

Phenotype

Characteristics you can see.

Progenitor cell

A daughter of a stem cell with more limited ability to become different cell types.

Regenerative medicine

Field of medicine focussed on healing the body by growing new cells, tissues or organs, to replace ones that are damaged or missing.

Revision surgery

Second surgery that fixes or replaces a previous surgery because it has stopped working properly or has caused problems.

Spin-out company

New business started by people from a university or research group to turn their discoveries into commercial products or services.

Stem cell

Type of cell with special properties; it can become many different cell types.

Synovium

Thin layer of tissue that lines the inside of our joints, protecting and lubricating these surfaces.

Tissue

Group of cells that work together to perform a certain function (such as cartilage tissue).

Tissue engineering

Field of science that grows or builds tissues to replace or repair damaged or missing tissues in the body.

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