ISSUE
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TCBE
COMMUNICATIONS
UPDATE

TCBENews

in this issue

Message from the Director

2011 was a busy, progressive and productive year for TCBE and 2012 is shaping up to be similar with consistently high research output. Our move to the Trinity Biomedical Sciences Institute will elicit further positive and expansive research activities in this world class research facility (pictured left).

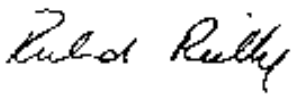
2012 has seen an increase in the number of grant proposals being submitted. The proposals span from specific basic research proposals to development of medical devices. A number of TCBE Principal Investigators are involved in joint Clinical Scientist submissions made to the Health Research Board. This demonstrates our greater influence on clinical research here to fore. Infrastructure is always important and TCBE Principal Investigators have been involved in a number of SFI proposals to increase facilities and research depth. We hope to report good news on these later in the year.

In 2011, we expanded our educational offering with the Graduate Engineering PhD programme in Medical Device Design and also the Neural Engineering Specialisation within the MSc Bioengineering. 2012 will see the start of the BAI MAI Undergraduate Bioengineering stream within the School of Engineering at Trinity College.

I am delighted to announce that the Provost of Trinity College, Dr. Patrick Prendergast has accepted our invitation to be the first Honorary PI of the Trinity Centre for Bioengineering.

Well done to Eamonn Sheehy, Stephen Thorpe, Claire Brougham and Roseanne Rafferty on their awards at the 2012 Bioengineering in Ireland Conference. TCBE researchers have a consistently strong record of awards at this annual event which is an endorsement of the high calibre research in Trinity Centre for Bioengineering.

We wish Dr. Biqiong Chen who was a Principal Investigator in TCBE the very best in her new role in the University of Sheffield.



TCBE PEOPLE & ACTIVITIES

NEW GRANTS

Title: VERVE
Programme: European Commission Seventh Framework Programme
PIs: Prof. Richard Reilly, Prof. Fiona Newell, Prof. Carol O'Sullivan
Budget: €4.8 million

Title: Functionalised nanoparticles for cancer imaging and therapy
Programme: Science Foundation Ireland Technology and Innovation Development Award (TIDA) 2011 programme - Feasibility Study. 12 months.
PI: Dr**.** Biqiong Chen (Principal Investigator), Lorraine O'Driscoll (Collaborator)
Budget: €99,228

Title: Porous decellularized hypertrophic tissue engineered cartilage as a scaffold for large bone defect healing
Programme: AO foundation, Switzerland
PI: Dr. Daniel Kelly (Principal Investigator), Prof. Fergal O'Brien (Royal College of Surgeons) and Dr. Mary Murphy, NUI Galway (Collaborators)
Budget: € 198,282(CHF 239,600)

Title: Development of a novel collagen-based film for corneal repair
Programme: Science Foundation Ireland (SFI)/ Enterprise Ireland (EI) Joint Technology Innovation Development Award Programme (TIDA). 2012-2013.
PI: O'Brien FJ (Principal Investigator), McCoy R, Clynes M, O'Sullivan F, Murphy C, Power W.
Budget: €128,715

Title: Translational Research Hub Seed Fund Award
Programme: Tissue Engineering/Stem Cell Research Consortium RCSI/DCU/NUIM
PIs: Prof. Fergal O'Brien (RCSI), Finbarr O'Sullivan (DCU), Dr. Kevin Kavanagh
Budget: €150,000 2012-2013.

Recently defended PhDs

Congratulations to Eoghan Maher, Stephen Thorpe, Alan Power, Hanifeh Khayyeri, David Bradley, Oana Istrate, David Hoey and Kevin Moerman who all recently successfully defended their PhD theses.

Hanifehs' thesis was titled "Computational investigations of variability in mechanobiological simulations of tissue differentiation"

Well done to David Bradley who was presented the David Marsden Award 2011 at the 5th International Dystonia Symposium held in October 2011 in Barcelona for his research paper "Temporal Discrimination Threshold: VBM evidence for an endophenotype"

Pictured l–r at David's PhD Viva are Dr. E. Lalor, PI TCBE; David Bradley; External Examiner, Dr Mark J Edwards, Senior Lecturer and Honorary Consultant Neurologist UCL Institute of Neurology and National Hospital for Neurology and Neurosurgery; Prof. Reilly, Director TCBE.

Alan Power is pictured here at his graduation on 8 December 2011. Alan is now is a postdoctoral fellow in Cambridge university in the Centre of Neuroscience and Education.

Stephen Thorpe's PhD was entitled "The effect of mechanical cues on the chondrogenic differentiation of bone marrow derived mesenchymal stem cells". He started a postdoctoral position in Queen Mary, University of London in January with Prof David Lee and Dr Martin Knight on the biophysical regulation of genome function and its role in mesenchymal stem cell differentiation and we wish him the very best.

Pictured above is Stephen carrying out stem cell research in his lab

Oana Istrate's thesis was titled "Polymer-clay nanocomposites". Well done, Oana!

Kevin Moermans thesis was titled "An Improved Framework for the Inverse Analysis of Skeletal Muscle Tissue In-Vivo"

On behalf of his group, Prof. O'Brien would also like to wish the best of luck to group-postdoc, Dr. David Hoey as he embarks on his independent academic career. David has recently taken up a lectureship in bioengineering in the University of Limerick but he will continue collaborations with TCBE.

SEMINARS & KEYNOTES

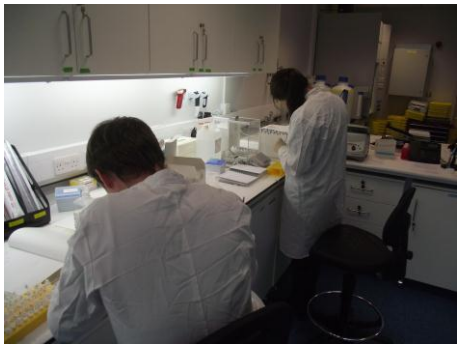
Prof. David Taylor delivered a seminar at the University of Southampton entitled "Fracture Mechanics of Biological Materials" in which he talked about current research in the TCBE on the fracture properties of bone, soft tissue and insect cuticle. He was also given a tour of their facilities, which include a very impressive suite of CT equipment, capable of imaging everything from the very large (greater than 1metre) to the very small (nano-CT). They have imaged various biological materials and organisms and would be interested to hear from anyone who might have a new application for this equipment.

Prof. Fergal O'Brien, at the invitation of Science Foundation Ireland and the Royal Irish Academy, represented the Irish scientific community at the World Economic Forum's Annual Meeting of the New Champions ('Summer Davos') held in Dalian, China. This is the foremost global business gathering in Asia and provides an unparalleled platform for global leaders to address the major drivers of growth in the 21st century. 40 young scientists (under 40 years) from around the world were invited to attend and interact with international business and political leaders.

Prof. Fergal O'Brien was an Invited Plenary Keynote Speaker at the European Symposium on Biopolymers Conference (ESBP2011) which was held in Dublin in September, 2011. His talk was entitled 'Advanced collagen-based scaffolds for tissue engineering applications'.

Dr. Daniel Kelly delivered an invited talk entitled "Stem cells for articular cartilage repair – Engineering the regenerative environment" at NUI Galway on the 2nd of December.

Members of Dr. Daniel Kelly's lab presented their work at the Orthopaedic Research Society annual meeting in San Francisco, California in February. Dr. Kelly gave a talk entitled "Engineering Osteochondral Constructs through Spatial Regulation of Endochondral Ossification". Dr. Conor Buckley and Dr. Yurong Liu presented posters based on their research and that of their colleagues in the lab.



Researchers at work in the new Regenerative Medicine Lab in Trinity Biomedical Sciences Institute

MSc CLASS of 2011

Congratulations and well done to all students in the class of 2011 on being awarded the degree of Master in Science in Bioengineering. Prof. Verkerke, the External Examiner, was very impressed and made particular tribute to the high quality of both the curriculum and our graduates following the exam board meeting. Chamanthi Karunasekara was awarded a certificate commending her for achieving the highest exam results in the TCD class of 2010/2011. Alan Ryan was commended for his dissertation entitled "Comparative analysis of a series of collagen-based scaffolds for bone tissue repair".

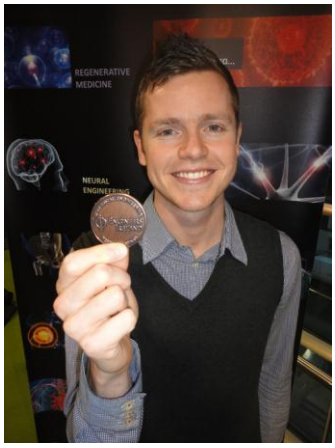
Alan Ryan being presented his certificate for commendation on his thesis from Prof Reilly

Our 2011 graduates are now pursuing exciting career paths in the field of biomedical engineering. Maria Cheung is enjoying a role as Research Associate position with Prof. Kesler's in Stanford University, researching the cognitive effects of chemotherapy using fMRI based protocols. Allison Cudworth joined the R&D department in Medtronic in Galway. Alan Ryan is continuing a PhD developing a collagen-based scaffold for cardiovascular tissue engineering with Prof .O'Brien in RCSI.

TCBE PEOPLE & ACTIVITIES

TCBE Award Winners at the 18th Annual Bioengineering...in Ireland[18]

Eamon Sheehy, postgraduate student of the Trinity Centre for Bioengineering, was recently awarded the 2012 Engineers Ireland Biomedical Research Medal for his contribution in the field of biomedical engineering for his PhD research.



Eamon was selected as the winner from a shortlist of four finalists after presenting his research paper at the 18th Annual Conference of the Bioengineering Section of the Royal Academy of Medicine in Ireland.

Eamon's research paper, entitled "Engineering Osteochondral Constructs through Spatial Regulation of Endochondral Ossification" focuses on using adult stem cells to engineer grafts to replace damaged tissues in joints such as the knee. At present there are limited surgical options for treating damage to the surface of synovial joints. Left untreated, these defects can lead to the development of osteoarthritis.

Eamon's research aims to address this problem by engineering tissue grafts in the laboratory that may in the future be used to treat damaged or diseased articular or elastic cartilage in joints. At the conference Eamon was presented with a commemorative Engineers Ireland medal and a cheque for €1000 sponsored by Boston Scientific.

At the same conference, Stephen Thorpe was awarded the Established Researcher Category award for his talk entitled "External Mechanical Stimulus can Override the Influence of Local Substrate in Determining Mesenchymal Stem Cell Fate". Both Stephen and Eamon's research is under the supervision of Dr Daniel Kelly, lecturer in the School of Engineering and Principal Investigator at the Trinity Centre for Bioengineering in the Trinity Biomedical Sciences Institute.

Congratulations to Claire Brougham and Rosanne Raftery who were also both award winners at the 18th Annual Conference of the Section of Bioengineering of the Royal Academy of Medicine in Ireland (RAMI) in Belfast. Claire won the DePuy sponsored plate for the best presentation by a new researcher with a talk entitled "Investigation of a New Material for Heart Valve Tissue Engineering". This is a collaborative project between Prof. Fergal O'Brien, Royal College of Surgeons in Ireland, Dr. Tom Flanagan, University College Dublin and Prof. Stefan Jockenhövel, Aachen University. Rosanne was awarded a prize in the same category for her talk entitled "Chitosan Nanoparticles as a Gene Delivery Vehicle to produce SMART Scaffolds for Bone Tissue Engineering". This project is collaboration between the Dept. of Anatomy and Dr Sally-Ann Cryan in the School of Pharmacy in RCSI. Pictured below is a photograph of Roseanne Rafferty, Prof. O'Brien and Claire Brougham

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E.G. Meyer, C.T. Buckley, A.J. Steward, D.J. Kelly The effect of cyclic hydrostatic pressure on the functional development of cartilaginous tissues engineered using bone marrow derived mesenchymal stem cells

Estrogen Plus Estrogen Receptor Antagonists Alter Mineral Production by Osteoblasts In Vitro
Erica G. Tierney, Garry P. Duffy, Alan J. Hibbitts, Sally-Ann Cryan, Fergal J. O'Brien

T. Vinardell, C. T. Buckley, S. D. Thorpe and D. J. Kelly Composition–function relations of cartilaginous tissues engineered from chondrocytes and mesenchymal stem cells isolated from bone marrow and infrapatellar fat pad

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in Response to Dynamic Compression
Matthew G. Haugh, B.A., B.A.I., Ph.D.,[1] Eric G. Meyer, B.S., M.S., Ph.D.,[1] Stephen D. Thorpe, B.A., B.A.I.,[1]
Tatiana Vinardell, D.V.M., IPSAV, M.Sc.,[1] Garry P. Duffy, B.Sc., Ph.D.,[1,2]
and Daniel J. Kelly, B.A., B.A.I., Ph.D. ,
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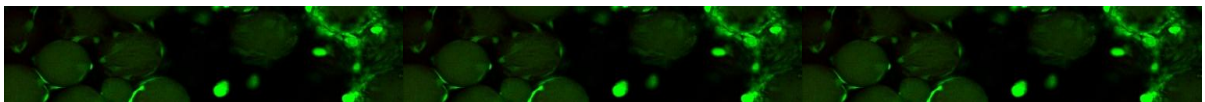
Nagel, T., Kelly, D.J. Apparent behaviour of charged and neutral materials with ellipsoidal fibre distributions and cross-validation of finite element implementations. Journal of the Mechanical Behavior of Biomedical Materials (in press).

The development of non-viral gene-activated matrices for bone regeneration using polyethyleneimine (PEI) and collagen-based scaffolds
Erica G. Tierney, Garry P. Duffy, Alan J. Hibbitts, Sally-Ann Cryan, Fergal J. O'Brien

Innovative Collagen Nano-Hydroxyapatite Scaffolds Offer a Highly Effi cient Non-Viral Gene Delivery Platform
for Stem Cell-Mediated Bone Formation
Caroline M. Curtin , Gráinne M. Cunniffe , Frank G. Lyons , Kazuhisa Bessho , *Glenn R. Dickson , Garry P. Duffy , and Fergal J. O'Brien*



TCBE MEDIA COVERAGE

European Commission Awards €4.8 Million to ICT Project that will help Older People and those with Neurological Disorders

A project aimed at improving the quality of life for disadvantaged groups including older people and those with neurological disorders has been awarded €4.8 million by the European Commission Seventh Framework Programme. The international project, named 'VERVE', is coordinated by Trinity College Dublin and includes collaborative partners in healthcare and academia in France, UK, Italy, Spain and Germany. The project kick-off meeting took place on October 3rd 2011 in Trinity College Dublin.

The project will develop tools to support the treatment of people who are at risk of social exclusion due to fear and apathy associated with ageing or a neurological disorder. The VERVE consortium will apply leading edge research to simulate personalised and populated virtual reality (VR) environments, 3D web graphics, and 'serious' games as a means to addressing some of the challenges faced by the target groups. A variety of clinical, laboratory and industry partners will help design the therapeutic tools and games, and evaluate their usefulness with participants.

Scene from *Metropolis* project

The project team will also work with those at risk of social exclusion, as well as their carers, families, health professionals and relevant support organisations, to solicit ideas and feedback and to promote the project's aims and achievements.

VERVE's efforts will focus on three situations, each targeting a different group of participants: fear of falling and Parkinson's disease; apathy related to cognitive decline and behavioural disturbances, in particular due to Alzheimer's Disease; and other emotional disturbances linked to anxiety. Although focusing on these areas initially, it is expected that the results of the research will be applicable to a much wider range of potentially disadvantaged individuals.

In addition to coordinating the project, Trinity's Graphics Vision and Visualisation (GV2) group, led by Prof Carol O'Sullivan, will build on their SFI-funded Metropolis project to create novel solutions for clinicians to create compelling scenarios depicting virtual humans, groups and crowds in a personalised virtual city environment. The Trinity College Institute of Neuroscience (TCIN) researchers, Professor Fiona Newell and Professor Richard Reilly, will bring their experience on the assessment and treatment of falls and frailty, and gait disturbances in Parkinson's disease, together with senior clinical collaborators such as Professor of Geriatric Medicine, Rose Anne Kenny in the Falls and Blackout Unit in St James's Hospital and Professor Tim Lynch in the Dublin Neurological Institute at The Mater Misericordiae University Hospital.

Commenting on the significance and aims of the project, Trinity College Dublin's Professor of Visual Computing and VERVE project coordinator, Carol O'Sullivan says: "The end goal of the novel ICT technologies being developed in VERVE is to increase user ability, allowing older people and those with neurological disorders to overcome their fear, apathy or phobia and thus carry out daily life activities in a fulfilling and dignified manner. The key to our success will be the fact that the clinical intermediary users will be actively participating during the development of the ICT tools and platforms, and will thus guarantee that the end result will be usable and accepted by the end-users."

The VERVE consortium partners are Trinity College Dublin (Ireland), Chu de Nice: Centre Hospitalier Universitaire de Nice; INRIA: Insitut National de Recherche en Informatique et Automatique, and CNRS: Centre National de la Recherche Scientifique (France), Testaluna (Italy), Kainos (UK), Universidad de Zaragoza (Spain) and DFKI: Deutsches Forschungszentrum für Künstliche Intelligenz (Germany).

On National TV

The VERVE project received coverage on RTE News

Dr. Ed Lalor, PI of Trinity Centre for BioEngineering, featured in a documentary on RTÉ on 23 January called 'Motor Neurone Disease - The Inside Track' about RTÉ Sports broadcaster Colm Murray and his participation in world-class scientific research, trials and studies to find a future cure for this disease.

On National Radio

Dr Bruce Murphy and his article 'Can you mend a broken heart?' published in the Irish Independent was referred to on RTE Radio 1 on 28th February 2012

TCBE MEDIA COVERAGE

ANATOMISTS, ENGINEERS & ARTISTS ANATOMY FROM THE OUTSIDE IN

The world's first 3D surface anatomy guide for medical and physiotherapy students, surgical trainees and artists has been developed in Ireland through a unique collaboration between anatomists, artists and engineers. Launched today in the Royal Hibernian Academy (RHA) in Dublin, the two year project, funded by Science Foundation Ireland and the Royal College of Surgeons Ireland (RCSI), has resulted in an on-line 3D guide which shows the motions of muscles and the sites of structures from the surface inwards. It shows how, by using movement, colour, illustration and 3D technology, anatomists, engineers and artists can collaborate to teach the body from the outside in.

The project was a partnership between anatomists Dr. Valerie Morris and Prof. Clive Lee from the Royal College of Surgeons (RCSI), engineers David Corrigan and Academy Award winner Anil Kokaram from Trinity College (TCD) and artists Mick O'Dea RHA and Una Sealy ARHA from the Royal Hibernian Academy (RHA).

The guide is about to be launched for surgical trainees in RCSI and in the College of Surgeons of East, Central and Southern Africa. In 2012, it will be used as the basis for teaching anatomy to artists in the RHA school.

Dr. Peter Clifford, SFI and Prof. Clive Lee, RCSI and with Medical students from RCSI at the launch of the 3D surface anatomy guide

Read full article:
http://www.sfi.ie/news-events/press-releases/irish-based-researchers-create-worlds-first-3d-surface-anatomy-guide/
Thursday, 8th December 2011

CONTACTLESS SENSORS DETECT DEVELOPING PRESSURE ULCERS

Medical-sensing technology could alert clinicians to the development of pressure ulcers in immobile patients before they form. The contactless system, developed by Irish researchers, focuses on detecting tissue blood flow — or perfusion — which when restricted can lead to ulcers. Currently there are methods to detect pressure at the interface between skin and supporting surfaces, but this only provides a proxy for perfusion. Perfusion itself can be measured using bulky apparatus such as ultrasound, plethysmography or electromagnetic.

Dr. Sonja Hermann said the information could potentially be used in conjunction with the pressure-release mattresses that some hospitals now use.....

Dr. Hermann and colleagues are now performing clinical trials in order to gain a better understanding of how different illnesses effect perfusion, with funding from the Irish Research Council for Science, Engineering and Technology (IRCSET) and Centre for Excellence in Universal Design. Given the extremely high costs of treating advanced-stage pressure ulcers, the team hopes to be able to commercialise its preventative technology and is looking for potential backers.

Read full article at :
http://www.theengineer.co.uk/sectors/medical-and-healthcare/news/contactless-sensors-detect-developing-pressure-ulcers/1010631.article#ixzz1ffdgpGsw

OFFERING STEPPING STONES TO LOCAL MANUFACTURING

Collaboration with the Trinity Centre for Bioengineering facilitated the development of a design and manufacturing capability within Moorings Mediquip in Ballymena that led to a new product, the Buddy Roamer, a walking aid to help children with physical mobility challenges. This was featured in the Irish Times on Monday 9th January 2012.

The Buddy Roamer is being manufactured by Co Antrim based SME Moorings Mediquip, which was given support through a project called InterTradeIreland Fusion. The scheme buddied-up the family business with Dr Ciaran Simms, a Principal Investigator in the Centre for Bioengineering at Trinity College, and an expert on biomechanics and a design graduate and the result is that they are now exporting the Buddy Roamer.

Read full article: Offering stepping stones to local manufacturing

Irish Times 9th January 2012

Can you mend a broken heart?

Dr Bruce Murphy is a Lecturer in Biomechanical Engineering at TCD and the Team leader of the Cardiovascular group within the Trinity Centre for Bioengineering. Pictured left holding a model of the heart

Dr Bruce Murphy

A team of engineers, scientists and cardiologists at Trinity College Dublin, Royal College of Surgeons Ireland and University Hospital Galway are doing their best!

Throughout a person's lifetime a number of elements of the heart can become diseased or damaged. In some instances these broken components need to be replaced or regenerated.

In one case, the valve between the two left heart chambers, the mitral valve, can become "leaky". In reasonably healthy patients open heart surgery can be performed, and is the gold standard.

However some people cannot be operated on due to an increased risk during open heart surgery, and in 50pc of mitral valve repair or replacement cases patients are refused surgery.

In order to address the patients who cannot tolerate surgery, we are designing a new mitral valve that can be delivered by a small tube either through the base of the heart or through the venous system.

Mitral valve surgery
TRINITY CENTRE FOR BIOENGINEERING

This new valve will restore the function of the mitral valve, allowing a patient's heart to function more efficiently while also reducing the risk of the procedure when compared to open heart surgery.

The approach we have taken to solve this problem is unique and a European patent application was filed in January 2011 to protect the intellectual property rights of our invention.

The project's success relies on a substantial number of experiments that will determine the device's safety and efficacy.

Subsequent venture capital funding will be required to progress the device through regulatory filings and clinical trials.

This project, funded by Enterprise Ireland, is a collaboration between my bioengineering research group at the Trinity Centre for Bioengineering and Dr Jim Crowley, a consultant cardiologist at University Hospital Galway.

In a second study at the Trinity Centre for Bioengineering, we are focused on repairing damaged heart muscle. In this case, the patient may have had a previous heart attack and part of the heart muscle may have become lifeless.

Our goal is to deliver a therapeutic compound to the area surrounding the damaged heart muscle. This therapeutic compound attracts the heart's own stem cell population to the area, and these stem cells have the potential to initiate repair of the damaged heart muscle.

There are multiple aspects to this project. The area that TCD team is focused on involves designing and testing devices that will deliver the therapeutics in the most efficient manner, while the development of the therapeutic compounds is taking place in parallel in Dr Garry Duffy's laboratory in the Royal College of Surgeons Ireland.

These projects are funded by the Programme for Third Level Research (PRTLI) and Enterprise Ireland.

TCBE researchers help to protect clear vision in patients with a particular eye disorder

MEDICAL RESEARCH: SOMETIMES research and innovation can transform lives. Work by Prof Fergal O'Brien has the potential to do just that, helping to protect clear vision in patients with a particular eye disorder.

Based at the Royal College of Surgeons in Ireland, O'Brien heads the tissue engineering research group in the department of anatomy. "The focus of the work we do is the use of collagen-based biomaterials for tissue repair in combination with stem-cell therapies," he explains. Collagen is the main component of connective tissue and is the body's most abundant protein. O'Brien is using it as a base material in cartilage repair and also in bone regeneration and in cardiovascular applications.

Because of this expertise, he was approached to develop a way to repair the cornea, the clear "window" of the eye. The cornea is protected by an essential outer layer of tissue called epithelial cells, and in some conditions this breaks down, something that over time can cause blindness. The eye produces limbal stem cells to repair damage to the epithelial layer, but if there are not enough – as in limbal stem-cell deficiency disorders – vision may degrade before repairs can occur.

O'Brien's team has developed a thin, transparent collagen scaffold and he plans to seed this with limbal stem cells and then use it as a protective cover for the cornea. "It will cover the surface of the eye and help regenerate the corneal surface," he says.

Enterprise Ireland funds some of his research, which is near to market, and last month, he received a Technology Innovation Development Award from Science Foundation Ireland. "I want to see these treatments coming into use and improving people's quality of life," he says.

– DICK AHLSTROM, Science Editor, Irish Times

http://www.tcd.ie/bioengineering/assets/pdf/12.03.12%20-%20Irish%20Times%20Business%20-%20Dublin%20team%20creates%20collagen%20and%20stem%20cell%20barrier%20against%20blindness%5b2%5d.pdf

Tissue engineering therapy to repair joint disease

By Dr. Danny Kelly *Tuesday February 28 2012, Irish Independent*

Read full article here http://www.independent.ie/national-news/dr-danny-kelly-tissue-engineering-therapy-to-repair-joint-disease-3032915.html

So, what exactly are you doing?

Current cell-based therapies can be used to treat isolated cartilage defects which otherwise might lead to ostheoarthritis in the long-term, but at present cannot be used to treat the disease. Even their use as a treatment option for isolated cartilage defects is limited in a number of ways.

Firstly, the repair is often temporary, and secondly, widespread adaptation into the clinical setting is impeded by practical issues such as the high cost and time required for such procedures.

We are working on a project aimed at developing novel solutions to these problems.

Our work might provide a way to prevent ostheoarthritis occurring, by treating isolated defects that, left untreated, could lead to the development of the condition.

Firstly, we want to determine whether adult MSCs, freshly isolated from the injured joint, can be used to engineer functional cartilage tissue.

The project builds on earlier findings from our lab that functional cartilaginous tissue can be engineered using MSCs isolated from within the intrapatellar fat pad of the knee.

The ultimate aim is to develop a cell-based therapy that, from MSC isolation to construct implantation, could be undertaken within hours in the clinical setting.

We are also exploring an alternative therapy for cartilage defect repair.

Specifically, the objective is to engineer in the lab a tissue with a structure and composition that mimics that of normal articular cartilage using MSCs.

This is important because the mechanical functionality of articular cartilage is derived from its structure and composition.

By re-engineering fully functional cartilaginous grafts in vitro, it is hoped that tissue engineering therapies can be expanded to treat larger defects to the joint surface.

Treating these larger defects requires a more mechanically functional tissue as the graft will be fully load-bearing from the time of implantation.

This is a critical challenge that needs to be overcome if in the future we are to scale-up these approaches to engineer biological joint replacement prosthesis as a treatment/cure for OA.

DR DANNY KELLY

Irish Independent | Tuesday 28 February 2012

BEHIND THE SCIENCE OF ...

bionic humans

Can you see a cure for osteoarthritis?

Dr Danny Kelly is a lecturer in TCD's School of Engineering and an Investigator at the Trinity Centre for Bioengineering, in Trinity Biomedical Sciences Institute. He has been awarded a President of Ireland Young Researcher Award (PIYRA) by Science Foundation Ireland.

He has also received a European Research Council (ERC) starter grant of €1.5m for his current research on adult stem cells. These awards are given annually to only 300 top scientists across Europe, less than 10pc of those who apply.

Dr Danny Kelly

Tissue engineering therapy to repair joint disease

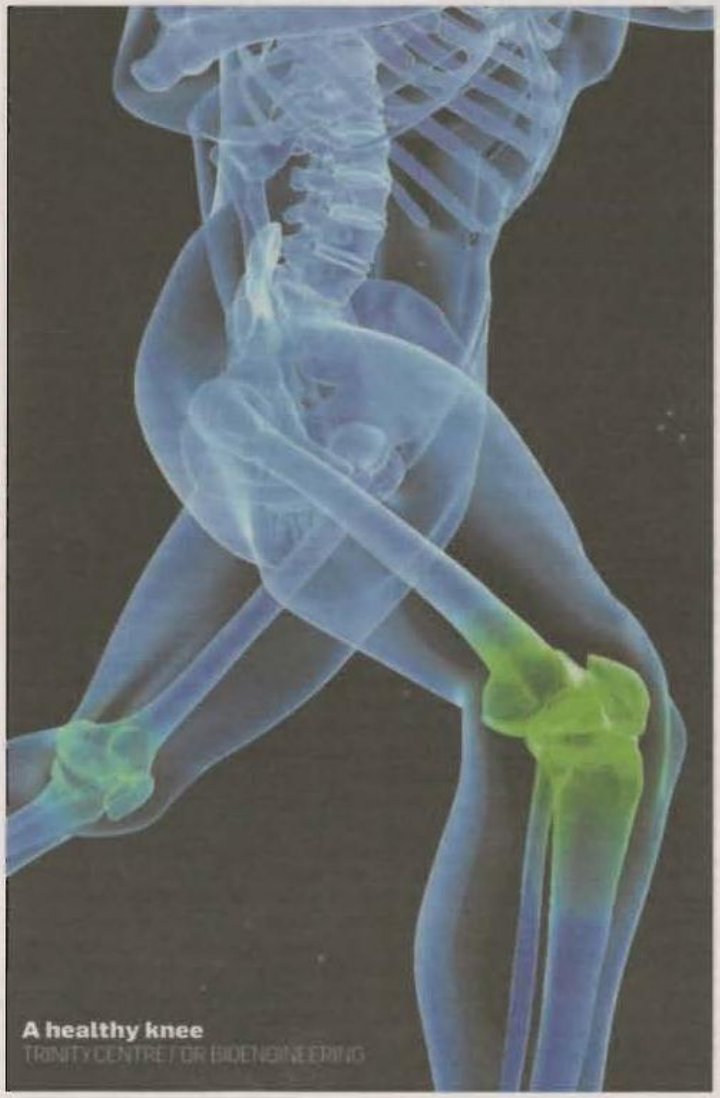
A LARGE proportion of patients presenting to orthopaedic surgeons with joint pain are suffering from osteoarthritis (OA), a disease of the joint, associated with significant degeneration of the articular cartilage that lines the surface of our bones.

The articular cartilage, a smooth tissue that covers the ends of bones where they come together to form joints, facilitates movement by allowing bones to glide over each other with very little friction.

Unfortunately, the tissue has a poor capacity for repair and therefore even small injuries or defects to the joint surface can progress to the painful and debilitating condition of osteoarthritis.

At present, the treatment options for OA are limited to surgical replacement of the diseased joint, such as a knee or hip, with a metal and polymer prosthesis. While this procedure is well established, it is not without its limitations and failures are not uncommon.

Joint replacement prostheses also have a finite lifespan, making them unsuitable for the growing population of younger and more active patients requiring treatment for OA.



A healthy knee
TRINITY CENTRE / DR BIOENGINEERING

The increasing prevalence of patients requiring treatment for OA is due to multiple factors, including lifestyle and occupational factors leading to increased incidence of trauma and greater levels of obesity in the general population.

Getting a joint replacement prosthesis at a younger age is a problem because you are more likely to outlive the prosthesis.

The field of tissue engineering has already led to the development of new treatment options to repair many different tissues and organs, including skin, blood vessels, trachea, bladder and bone.

These breakthroughs provide confidence that tissue engineering therapies will also one day provide a cure for OA.

In the future, it may be possible to tissue-engineer biological joint replacements prosthesis using stem cells, called mesenchymal stems cells (MSCs), that can be isolated within damaged or diseased joints to regenerate and repair articular cartilage which would prevent arthritis.

If successful, such a concept could form the basis of a novel tissue engineering therapy for treating degenerative joint disease such as OA.

Controlling Asthma, Improving Quality of Life

Did you know that Ireland has the fourth highest prevalence of asthma in the world? It is proposed that new modern lifestyles adopted by Irish people over the last few decades have contributed to such high rates of asthma. Many believe that changes in our housing conditions, national diet and increasingly sterile home environment may have contributed to this rise. Over 470,000 people in Ireland have been diagnosed with asthma, with 1 out of every 5 children suffering from this chronic respiratory disease. Asthma is the most common cause for children to miss days in school and to visit the doctor. A substantial burden is being placed on our economy due to chronic diseases such as asthma. Research is being carried out in Trinity College Dublin to positively change asthma treatment in this country; research which has the potential to improve numerous people's quality of life.

In asthma the airways of the lungs become narrow, constricted and inflamed. The most common symptoms are breathlessness, wheezing, tightness of the chest and coughing. Asthma occurs when the airways react to irritating substances, more commonly known as triggers. Common triggers include allergens such as pollen and dust mites, tobacco smoke and chemical irritants from cleaning products. Although there is currently no cure for asthma, it can be effectively controlled. Inhalers that are used to deliver medication directly into the lungs can be classified as either reliever inhalers (providing immediate relief to patients finding it difficult to breathe, such as during an asthma attack) or preventer inhalers (medication to prevent symptoms developing).

Although many people are familiar with asthma and how it can be treated, what people may not be aware of is the failure by many people to control their asthma symptoms. Controlling asthma is as simple as taking the correct medication at the correct times and using inhalers correctly. It may sound easy but how many of us who have asthma, myself included, have missed a dose due to forgetfulness or used an inhaler incorrectly while rushing out the door in the morning to school or work? It is surprising how many people do not know how to use an inhaler correctly. Many people take the wrong dosage of drug by excessively inhaling, some do not hold their breath long enough after they have inhaled and some people even exhale instead of inhaling!

According to latest figures from the Asthma Society of Ireland, up to 60% of Irish people do not have control of their condition. This is a sad reality as a large proportion of the 70 or so people who attend A&E and the 16 people who are admitted to hospital every single day is preventable with appropriate asthma control. Tragically, asthma also claims the life of more than one person every week in Ireland. Increasing the number of people in control of their asthma would be a win-win scenario: Patients would enjoy an increased quality of life and less hospitalisations, clinicians would have more time to deal with other patients, while Irish government spending on asthma (€463 million in 2003: Asthma Society of Ireland) would be greatly reduced.

Good asthma control is possible through education, appropriate medication and following a personal asthma management plan. In order to deal with the issues of poor asthma control, a device was developed at Trinity College Dublin to actively monitor the way in which inhalers are used by patients. The device, which can be attached to an inhaler, records the time that the inhaler was used and also the acoustics of inspiration and expiration during each use (recorded through a microphone in the device). Given that the device provides information on 'when' and 'how' an inhaler was used, there is a great deal of potential to use the device in improving patient's usage of inhalers. Knowing 'when' patients use their inhalers is an important step in understanding how adherent they are to their prescription, while knowing 'how'

Controlling Asthma, Improving Quality of Life

they use the inhaler reveals vital information about their technique. Analysing inhaler audio recordings involves using an algorithm (a computer program which executes a set of predefined steps) to automatically check if the correct procedure for using the inhaler was followed. The signal processing algorithm automatically identifies the opening of the inhaler, the release of the drug and the inhalation of the drug. The device was licensed to Vitalograph just under a year ago and several clinical trials are currently taking place across Ireland to verify its potential.

Our device can provide valuable feedback to both patients and clinicians on whether the inhaler has been used correctly or not, something which has not previously been carried out. Information from the device provides clinicians with empirical evidence which they can use in their treatment of individual patients, thus making a larger impact in the lives of asthma sufferers. By giving patients feedback on their inhaler adherence and technique it is hoped that they will take control over their asthma and improve the effectiveness of their treatment. Increased adherence and improved technique has been demonstrated to improve the quality of life of sufferers of asthma. Before this new device was developed, clinicians had no way of knowing if patients used their inhalers correctly and were often left puzzled as to why patients weren't responding to treatment. This new device solves this problem and may be the missing piece of the asthma control puzzle.

Reducing the levels of uncontrolled asthma in Ireland and internationally will not be an easy task. However the new device and software being developed in the Trinity Centre for Bioengineering is going some way to solve this important problem. The end outcome is that patients, working in partnership with their clinician, will be able to significantly reduce the burden of asthma on their daily life. At a time when the Irish government is promising to get Ireland working, this research's impact is aiming to get asthma sufferers working, which is out of our hospitals, less missed days at school/work and living life to the full.

PhD GREP student Martin Holmes wrote this article for his submission on the difference that his research will make to a particular aspect of Irish life and the country as part of a competition run by the HEA/Irish Independent.

IMA CONFERENCE ON MATHEMATICS OF MEDICAL DEVICES AND SURGICAL PROCEDURE

17 – 19 September 2012
University College London

CALL FOR PAPERS

Mathematics is playing an ever increasing role in the area of health and medicine, through the use of modelling, statistics, and virtual simulations. These mathematical tools are becoming invaluable in testing the feasibility of surgical procedures and medical devices prior to clinical trials. Furthermore, there is a very realistic possibility over the next twenty years that computer models coupled to patient-specific imaging will be used in real time in the clinical environment to directly advise on treatment strategies. The aim of this conference is to bring together the diverse community of mathematicians, engineers, physicists, clinicians involved in using applied sciences and mathematics to develop and use medical devices to discuss both the latest research and the needs of the clinical community and patients.

The topics that will be discussed will broadly include cardiovascular devices, medical imaging, ophthalmology, cell biology, disease transmission, orthopaedic, advanced simulations, as well as health in ageing. The conference programme will include keynote speakers drawn from both clinical and mathematical communities, along with contributed presentations and poster sessions. The programme will also include breakout sessions in certain topics as well as refreshment breaks for informal discussions. Social events include a drinks reception and a conference dinner.

Further information
For further information on this conference, please visit the conference webpage:
http://www.ima.org.uk/conferences/conferences_calendar.cfm

Welcome to TCBE

We would like to welcome Dr Tongfei Wu and Clive Curley

Dr. Tongfei Wu was awarded an IRCSET ENPOWER Postdoctoral Research Fellowship and joined Dr. Chen's group in December 2011. He has a BSc in chemistry from Sun Yat-sen University, and a PhD in polymer science from Institute of Chemistry, Chinese Academy of Sciences (2009). Prior to joining Dr. Chen's group, he held research positions at Nanyang Technological University, Hong Kong University of Science and Technology, and University of Toronto. His main research interests include polymer-matrix nanocomposites and biomimetics. The IRCSET project title is "Novel Biomimetic pH/Light Responsive Mechanically Adaptive Nanocomposites".

Clive Curley is a new PhD student in the Cardiovascular group.

After completing his undergraduate studies in Mechanical Engineering in Trinity College, Clive worked in the Aerodynamics
Lab in Helsinki University of Technology and the HSG Microsystems Institute in Germany before becoming a postgraduate of the M.Sc. in Bioengineering in Trinity College. Clive's PhD is funded by the PRTLI GREP programme and focuses on the development of a new catheter that is capable of injecting cardiac stem cells embedded in a gel into the wall of infarcted hearts.

Coronary heart disease is a major killer and though many medications slow its progression none are capable of reversing it. Stem cell therapies aim to change this by promoting and causing growth of new tissue and vasculature. Cardiac stem cells are the latest and most promising therapeutic with recent human trials showing substantially significant reduction in scar size and growth of healthy tissue. Clive's project intends to provide commercially viable tools that will further increase the efficacy of such therapies, will speed up the therapeutic administration procedure and will aid its clinical accessibility.

Clive is currently conducting a study into the size and geometry of the chamber of the heart where the cells will be injected by constructing 3D computer models from CT scans (figure 1)and then analysing them with Matlab. After this he will be doing a physical study optimising needle insertion technique into heart muscle.

For the next edition
please submit any articles, images or news you would like communicated to June tcbe@tcd.ie. This can include all recent papers and publications, awards, new grants, new recruits and team members, conferences attended, press and media coverage, research opportunities, upcoming seminars etc.