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Directors Message

Welcome to the spring 2016 newsletter of the Trinity Centre for Bioengineering. The past few months have again been a very productive period for the PIs, postdoctoral researchers and students associated with the Centre. Details of all our recent outputs and activities can be found within this newsletter, but I'd like to highlight just a few of them here.

Firstly, congratulations to all the 2015 MSc in Bioengineering class who graduated in April. The MSc programme continues to go from strength to strength, and was again shortlisted for the GradIreland award for best postgraduate course in engineering.

One of the most important metrics of success is to see research from our labs translate into new products and spin-out companies. In that regard, it is great to see the progress that Dr Conor Harkin, Prof Bruce Murphy and everyone else involved with ProVerum are having with their new medical device to treat benign prostate hyperplasia. I look forward to hearing of their continued success over the coming months.

Finally, congratulations to everyone who successfully defended their PhD theses over the past few months. I wish you all the best in your future endeavours.

Daniel Kelly



A minimally invasive device for the treatment of Benign Prostatic Hyperplasia (BPH).

The TCBE Medical Device and Drug Delivery Research Group have developed a medical device that makes it easier to treat benign prostate hyperplasia. (BPH). BPH affects approximately 50-60% of men over the age of 50. In the United States alone, around 28 million men are living with the condition, of whom 13 million are symptomatic and around 4 million are on drug therapy. In BPH, the walnut-shaped prostate gland that surrounds the urethra enlarges and compresses the urethra, the channel used for urination and ejaculation. This can result in frequent urination (including the need to go to the bathroom several times in the night), weak urinary flow, and even, in severe cases, kidney failure. Based in the Trinity Centre for Bioengineering (TCBE), we have developed a device, ProVerum, to restore function to the water passage (urethra) in BPH. This will allow patients with this condition to urinate normally, relieving their symptoms while not interfering with sexual function. The ProVerum treatment is carried out under local anaesthetic as a day procedure. It only takes 15 minutes and has significantly fewer side effects than surgery.



The ProVerum team, based in TCBE includes CTO Riona Ni Ghriallais who has worked in medical device R&D and R&D engineer [Michael Burke](#). Prof [Bruce Murphy](#), Deputy Director of TCBE is a technical adviser to the project while consultant urologist Prof Thomas Lynch of Trinity and St James's Hospital is the lead clinical adviser.

6 months pre-clinical data demonstrates efficacy and safety of the device. ProVerum will be spun out as a campus company later this year and the device will come to market in 2018.

Proverum, was featured at Enterprise Ireland's Big Ideas

Event. See <http://newsletter.enterpriseireland.com/1kwn9z9fhoo1cs7punpgq5?a=1&p=49595676&t=22180395>

Dr Conor Harkin, founder of ProVerum, also featured in the Irish Times on 7 March 2016 as New Innovator. See full article here:

<http://www.irishtimes.com/business/proverum-offers-minimally-invasive-treatment-for-bph-1.2556779>

"This is the Trinity Centre for Bioengineering's first medical device campus based spin-out company and there are exciting times ahead for the team as they aim to improve the lives of patients with Benign Prostate Hyperplasia (BPH)" Prof. Bruce Murphy

On National Radio:

TCBE Principal Investigator, Associate Prof. Ciaran Simms, was on the radio talking about safety evaluations for car seats for babies. Entrepreneur Christine Carolan has invented the Cosynest, a baby wrap which allows babies to be better secured into their car seat.

Associate Professor Ciaran Simms from the Department of Mechanical and Manufacturing Engineering carried out high-speed crash testing which has shown that the product came out as the safest compared with a conventional snow suit-style restraint. Associate Professor Ciaran Simms said that retaining the child in its car seat is crucial to its safety. "The Cosynest showed a better capacity to retain the child in the seat than a conventional snow suit".

Listen [here](#) to Christine Carolan and Ciaran Simms on Today FM.

TCBE EDUCATION: MSC IN BIOENGINEERING

MSc Bioengineering class of 2015 Graduation

Congratulations to all of class 2015 who graduated on 7 April 2016. We wish them the very best in their futures in the field of bioengineering.



“Educating Students in Engineering and Medicine”

Dr. Buckley has played a major role in recently establishing a new European foundation “Educating Students in Engineering and Medicine (ESEM)” and is a co-founding board member and current treasurer for this exciting initiative. ESEM is a non-profit foundation which focuses on the education in the field of biomedical engineering in Europe. The vision is simple: **Create a better future through optimal education for students in Engineering and Medicine in Europe and beyond.**

A European approach in education in the field of biomedical engineering will prepare students for a European future. Students should be trained in all fields of BME. In addition, they should acquire knowledge of other cultures, languages, habits, training; this should be realized:
 via summer schools for Bachelor students
 via a European Master’s for master-students
 via a common training programme for PhD-students
 networking and exchange of ideas across Europe
 For more information please visit: www.esem.eu

Med – 3P

This year has also seen the introduction of a new element of the Design/Innovation module of the MSc in Bioengineering which Dr. Buckley has spearheaded called MED-3P.



Projects Downloads About Contact



MED-3P is an initiative to develop medical devices for humanitarian healthcare using 3D printing technology. This allows students to apply their training and technical skills to real life problems thereby impacting humanitarian healthcare and contributing to society.

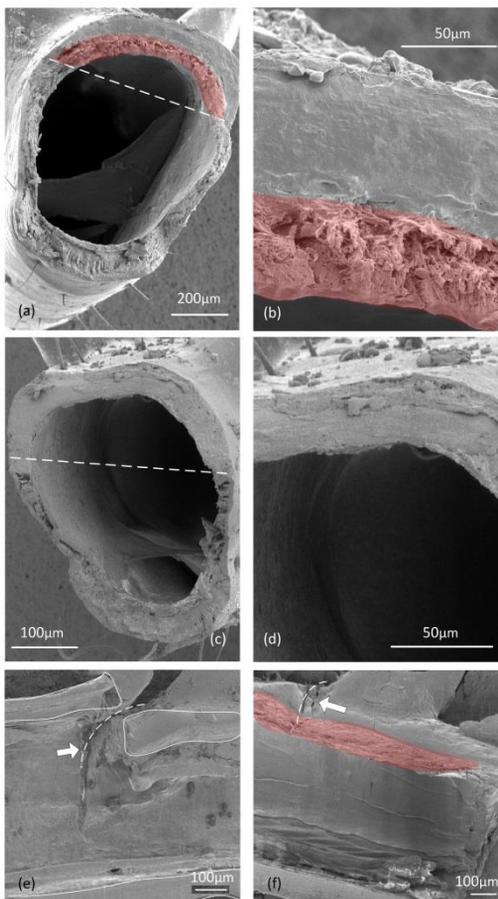


Pictured above is the Med – 3P Team

Dr. Buckley has been appointed a committee member of the TCD Animal Welfare Body (AWB). AWB is a statutory committee of the college. It plays a serious role in managing and controlling animal welfare and compliance and the integrity of the animal facility.

CAN INSECTS REPAIR THEIR BONES?

Biomechanics researchers Prof David Taylor and colleagues at Trinity College Dublin discovered that, if you cut the leg of an insect, it will make a patch of new material underneath the cut which acts as a kind of internal bandage. Unlike us, insects cannot completely repair their bones, but it turns out that, using this patch, they can do a pretty good job, restoring most of the original strength and allowing them to keep using the leg for normal activities. This is the first ever study of the biomechanics of repair in arthropods.



Cross sections of locust legs: the areas coloured pink are newly deposited cuticle to repair incisions created a few weeks earlier.

AWARDS & GRANTS

Professor Richard Reilly has been selected to receive a 2016 IBM International Faculty Award. IBM quoted that "This award is highly competitive and recognizes the quality of your program and its importance to our industry".

Principal Investigator – Trinity College Dublin Research Capacity Building Grant- Pathfinder (2015) €18,500

Project title: Towards a Single Stage Procedure for Intervertebral Disc Repair using Nasal Derived Chondrocytes (NasDisc)

Description: Autologous Disc Cell Transplantation (ADCT) has been in clinical use for the treatment of degenerated IVD in a similar manner to those currently used for cartilage repair of the knee joint. Although these therapies have made it to the clinical setting there are significant concerns regarding its effectiveness due to issues of cell leakage following cell injection into the disc, the limited tissue forming capacity of culture expanded NP cells derived from degenerated tissue and questions as to whether the number of nucleus pulposus (NP) cells that can be isolated from a degenerated disc is sufficient to meet the requirements for successful treatment. Therefore, there is a need to identify an alternative cell source for the development and clinical translation of next generation therapies for IVD regeneration. The objective of this proposal is to determine the feasibility and the subsequent tissue forming capacity of freshly isolated nasal septal derived chondrocytes on porous microcarriers to augment tissue regeneration as part of a single stage procedure.

Funded by: Research Capacity Building Grant by TCD Research Committee

Congratulations to TCBE's most recent PhD graduates Adam O'Reilly, Henrique Almeida, Martin Holmes and Gerard Loughnane.

EVENTS, SEMINARS & CONFERENCES

Keynote Address

'The Future Clinical Engineer'

Prof Richard Reilly gave a keynote address on the Future Clinical Engineer at the 2016 Biomedical & Clinical Engineering Association of Ireland Annual Scientific Conference.

Conferences Attended

TERMIS

Members of Dr Buckley's BIOMATERIALS AND TISSUE ENGINEERING RESEARCH GROUP, Masooma Naqvi and Srujana Vedicherla presented their work at the 4th **Tissue Engineering and Regenerative Medicine International Society (TERMIS) World Congress**, 8th-11th September 2015, Boston, USA.

Binl 2016 Conference

Congratulations to all prize winners at this years Bioengineering in Ireland conference which was held in Galway in January.

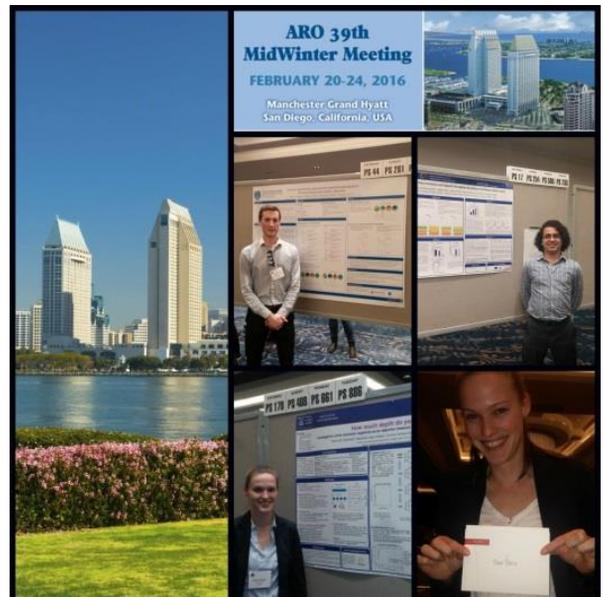
Four TCBE researchers were short-listed for the Engineers Ireland Biomedical Research Medal which was won by Ms Claire Brougham, a PhD student in Prof. Fergal O'Brien's team. awarded annually to a PhD student deemed to be making the greatest contribution to the field of biomedical engineering research as evidenced by the submission of a research paper and delivery of a presentation summarising their work. Ms Brougham's paper, entitled "Dynamic stimulation allows development of a functional tissue engineered heart valve", was selected as the winning presentation from 24 initial submissions and 4 finalists by a panel of eight interdisciplinary judges. PhD students, Tomas Gonzalez-Fernandez and Andrew Daly were also selected as one of the 4 finalists.

Binl 2016 Conference

Ms Fionnuala O'Gorman, an MSc student supervised by Dr Cathal Kearney's TERG team, was awarded the prize for best oral presentation in the Gene/Drug Delivery category. Ms O'Gorman's talk was entitled "On-demand delivery of pDNA-nanoparticles from polymer based delivery systems".

Mr Alan Ryan from Prof. O'Brien's team and a graduate of the MSc Bioengineering, was awarded the prize for best oral presentation in the Tissue Engineering of Vascular Networks and Nerves category. Mr Ryan's talk was entitled "Biofabrication of physiologically relevant vascular grafts using natural polymers and a custom vascular bioreactor".

ARO MidWinter Meeting - Association For Research In Otolaryngology was held in San Diego in February. Members of the Neural Group, Alejandro Valdes, Denis Drennan and Saskia Waechter attended. Congratulations to Saskia who won 3rd Prize for best speaker at the poster blitz section. Only 22 presenters were shortlisted from all the posters at the conference.



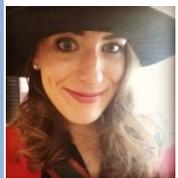
NEW TO TCBE



Swetha Rathan

Swetha joined TCBE as a postdoctoral research fellow with Prof. Daniel Kelly in Jan 2016. She graduated with Bachelor of Technology in Chemical Engineering from Osmania University, India. Swetha pursued her Ph.D. in Chemical and Biomolecular Engineering from Georgia Institute of Technology, Atlanta, USA. Her doctoral research focused on aortic valve mechanobiology, where she identified the shear- and side-dependent microRNAs involved in aortic valve disease *ex vivo*. She also investigated the role of inorganic pyrophosphate in preventing aortic valve calcification *ex vivo*.

Swetha's current research work in TCBE is to engineer biomimetic hydrogels for cartilage regeneration to treat osteoarthritis. Injectable hydrogel encapsulated stem cell based therapies offer promising alternatives to painful and expensive surgeries. Her research is focused on developing a 3D printable MSC-laden biomaterial that is both immediately load-bearing and can facilitate the regeneration of articular cartilage. These biomaterials will be primed with biophysical and biochemical cues to further aid the cartilage regeneration. These biomaterials will be optimized *in vitro* and their pre-clinical efficacy will be evaluated using appropriate *in vivo* models.



Fiona Freeman, PhD

After obtaining her Bachelor's degree in Biomedical Engineering in NUI Galway in 2011, Fiona began her PhD in the Biomedical Engineering department in NUIG with the title "Endochondral Ossification: A new strategy for bone tissue regeneration". The PhD work involved developing and implementing novel *in vitro* strategies for *in vitro* priming of constructs with the aim of generating the optimal format for implantation and bone formation *in vivo*. Fiona's PhD focused on trying to replicate the endochondral ossification process, specifically she focused on determining the optimal format for implantation and bone formation *in vivo*. Currently, as a postdoctoral researcher, Fiona's research is aimed at developing an innovative methodology that relies on replicating the cellular, biochemical and mechanical environment during endochondral ossification in order to further enhance the bone regeneration potential of bone tissue engineered constructs.

Congratulations to TCBE PI Edmund Lalor (Assistant Professor, School of Engineering, Trinity Centre for Bioengineering and Trinity College Institute of Neuroscience) who came first in the 2016 TCD CAMPUS 5K staff category beating the time of world champion, Sonia OSullivan

Pictured right is Sonia O'Sullivan, Irish athlete with Asst. Prof. Ed Lalor

TCD CAMPUS 5K 2016



Naqvi S.M., Vedicherla S.V., Gansau J, McIntyre T, Doherty M and Buckley C.T. "Living Cell Factories"-Electrosprayed Microcapsules and Microcarriers for Minimally Invasive Delivery. *Advanced Materials (In press)*, PMID: 26695531

Naqvi, S.M. and Buckley, C.T. Bone Marrow Stem Cells in Response to Intervertebral Disc-Like Matrix Acidity and Oxygen Concentration - Implications for Cell-Based Regenerative Therapy. *Spine (In press)*, PMID: 2663043.

Sanders, R., Kearney, C, Buckley, C.T., Jenner, F. and Brama, P. Knot security of 5 metric (USP 2) sutures: influence of knotting technique, suture material, and incubation time for 14 and 28 days in phosphate buffered saline and inflamed equine peritoneal fluid. *Veterinary Surgery, 44(6): 723 – 730, 2015.*

Almeida, A.V, Rajalakshmanan, E., Cunniffe, G.M., Buckley, C.T., O'Brien, F.J., Kelly, D.J. Fibrin Hydrogels Functionalized with Particulated Cartilage Extracellular Matrix and Incorporating Freshly Isolated Stromal Cells as an Injectable for Cartilage Regeneration. *Acta Biomaterialia (in press).*

Lu, L., Chu, J., Rajalakshmanan, E., Mulhall, K., Kelly, D. J. Engineering tissues that mimic the zonal nature of articular cartilage using decellularized cartilage explants seeded with adult stem cells. *ACS Biomaterials Science & Engineering (in press).*

Almeida, A.V, Rajalakshmanan, E., Cunniffe, G.M., Buckley, C.T., O'Brien, F.J., Kelly, D.J. Stem cells display a donor dependent response to escalating levels of growth factor release from extracellular matrix-derived scaffolds. *Journal of Tissue Engineering and Regenerative Medicine (in press).*

Luo., L., O'Reilly, A., Thorpe, S., Buckley, C.T., Kelly, D.J. Engineering zonal cartilaginous tissue by modulating oxygen levels and mechanical cues through the depth of infrapatellar fat pad stem cell laden hydrogels. *Journal of Tissue Engineering and Regenerative Medicine (in press).*

Matsiko, A., Thompson, E., Kelly, D.J., Gleeson, J., O'Brien, F.J. An endochondral ossification-based approach to bone repair: Chondrogenically-primed MSC-laden scaffolds support greater repair of critical-sized cranial defects than osteogenically stimulated constructs in vivo. *Tissue Engineering (Part A) (in press).*

O'Reilly, A, Hankenson, K., Kelly, D.J. A computational model to explore the role of angiogenic impairment on endochondral ossification during fracture healing. *Biomechanics and Modelling in Mechanobiology (in press).*

O'Reilly, A., Kelly, D.J. The role of oxygen as a regulator of stem cell fate during the spontaneous repair of osteochondral defects. *Journal of Orthopaedic Research (in press).*

Kearney, C. J., Lucas, C. R., O'Brien, F. J. and Castro, C. E. (2016), DNA Origami: Folded DNA-Nanodevices That Can Direct and Interpret Cell Behavior. *Adv. Mater.* doi:10.1002/adma.201504733

O'Leary C., Cavanagh B., Unger RE., Kirkpatrick CJ., O'Dea S., O'Brien, F. J. and Cyran SA. The development of a tissue-engineered tracheobronchial epithelial model using a bilayered collagen-hyaluronate scaffold [doi:10.1016/j.biomaterials.2016.01.065](https://doi.org/10.1016/j.biomaterials.2016.01.065)

Current Vacancies

ERC FUNDED PHD STUDENTSHIPS IN BIOREACTOR DESIGN

Following the award of a European Research Council starting grant, a funded PhD studentships has become available in the area of bioreactor design. The aim of this project will be to develop a bioreactor system suitable for engineering corneal tissue. The successful candidates will receive training in a variety of biological and bioengineering techniques and have access to state-of-the-art facilities at the Trinity Centre for Bioengineering and the Department of Mechanical and Manufacturing Engineering. There will also be the opportunity to attend international conferences.

Candidates should ideally have a 1st class honours primary degree or MSc degree in a relevant science or engineering discipline. Experience or knowledge in any of the following is desirable but not essential as training will be provided: instrumentation design; imaging systems; cell culture; biomaterials; tissue engineering and ophthalmology.

The funded PhD Studentship at Trinity College Dublin, University of Dublin are available that include fees (at EU student rate only) and a competitive stipend starting 1st September, 2016. Closing date for applications is 1st May 2016. Interested candidates for this exciting opportunity should send a CV, cover letter and contact details for two referees to Prof. Mark Ahearne via e-mail (ahearnm@tcd.ie). Informal enquires are welcome.

Further details about Prof. Ahearne's research and the Trinity Centre for Bioengineering can be found at <http://ahearne.openwetware.org/> and <http://www.tcd.ie/bioengineering/>

RESEARCHER FELLOW IN DATA ANALYSIS, PROBABILISTIC MODELLING, MACHINE LEARNING AND PREDICTION OF BIOACOUSTIC DATA

The Neural Engineering Group within the Trinity Centre for Bioengineering at Trinity College Dublin invites applications for a Post-Doctoral Researcher to develop analysis methods to detect inhaler acoustics and to investigate the relationship between temporal and spectral features of the acoustic recordings and user characteristics (inspiratory & exhalation flow rates, volume measurements, etc.). It is hypothesized that features obtained from the acoustic recordings estimate indices of respiratory function, such as PIFR and IC, and that from analysis of inhaler acoustics one can provide objective measurement on patient inhaler use and their respiratory health.

The post requires expertise in acoustic data analysis, machine learning and data prediction.

It offers the opportunity to join a dynamic, translational biomedical engineering-clinical team. This position will be in collaboration with the Royal College Surgeons in Ireland and funded by the Health Research Board and Enterprise Ireland and will be initially for 12month period with the possibility to extend for a further 12months.

For more information please see <http://reillylab.org/open-positions/postdoctoral-researcher-acoustic-processing/>