Leeds Dental Institute is a clinical academic centre and part of the Faculty of Medicine and Health at the University of Leeds, UK. We work with colleagues across the University to achieve our shared vision of improving health and reducing health inequalities at international, national and local levels through the delivery of research excellence with impact.

Our partnerships with academic collaborators, industry and the National Health Service (NHS) are at the core of our activities and support the development of our expertise to provide a balanced portfolio of fundamental and translational research.

This research and innovation guide features ongoing case studies which highlight the depth and breadth of research expertise and innovation that can be accessed at Leeds Dental Institute.
Leeds Dental Institute

In the last UK Research Assessment Exercise 60% of our dental research was rated as world leading or internationally excellent.

Our outstanding strength in basic sciences and holistic approach to world-class research are central to our ability to offer a seamless continuum from the laboratory to the clinic and to our aim of providing an exceptional experience for our postgraduates. Leeds Dental Institute’s flagship Wellcome Trust funded Dental Translational and Clinical Research Unit provides an excellent environment to accelerate research innovation for patient benefit.

Leeds Dental Institute offers access to an inter-disciplinary team of clinical and basic science researchers with international reputations in their respective fields and is supported by excellent facilities.

We have the capacity and expertise to respond rapidly and effectively to the needs of our partners and stakeholders, and pride ourselves on understanding their drivers, goals and delivering to their needs.

Working together with our partners and students we have never been better placed to address clinical innovation challenges and deliver our vision of underpinning excellence in clinical research with outstanding basic science.
UNIVERSITY OF LEEDS

The University of Leeds is ranked among the top 100 universities in the world*. It is a major economic and cultural contributor to Leeds and the surrounding region. The University is focused on creating a major impact on global challenges facing society with its distinctive ability to integrate world-class research, scholarship and education.

Leeds is one of the UK’s top research universities with more than 61% of our research rated as ‘world leading’ or ‘internationally excellent’, securing the University 8th place for research power in the 2008 Research Assessment Exercise (RAE).

The University actively encourages and supports an enterprising spirit. Since 2006, Leeds has filed more than 85 patents, incubated 63 companies founded by undergraduates and helped create 45 innovative spin-out companies valued at an estimated £150 million.

Staff and students from Leeds Dental Institute work closely with academic colleagues across the wider University to harness the full potential of research through the development of new ideas and investigation of global challenges.

*RANKED AMONG THE TOP 100 UNIVERSITIES IN THE WORLD*
Funded via a prestigious £1.7 million capital award from the Wellcome Trust/University of Leeds, DenTCRU is a state-of-the-art research clinic dedicated to the delivery of world-class translational and clinical research in dentistry.

DenTCRU provides our researchers with an environment in which:

- to expedite the roll-out of our research in interdisciplinary dental sciences for patient benefit ‘from bench to patient and back again’
- to train the next generation of clinical academics in high quality clinical research
- Leeds clinicians can work with colleagues across the University and beyond in establishing the evidence base for dental treatment and delivery.

Equipped to an exceptionally high standard, DenTCRU has six high specification dental units and supporting laboratory infrastructure, providing researchers with access to non-invasive intra-oral diagnostics, high throughput microbiological molecular screening and stem cell-based therapies and devices in regenerative skeletal medicine. Working closely with the renowned University of Leeds Clinical Trials Research Unit ensures that our clinical research is performed to the highest standards of clinical governance and rigour.

Benefits

DenTCRU is a dedicated facility through which we achieve our vision of delivering research excellence with impact for our staff, students, partners and collaborators. It supports our work in sustained partnerships with a wide range of partners and stakeholders from major international companies to our local community.
SKELETAL TISSUES RESEARCH BANK

Leeds Dental Institute received Research Tissue Bank status in November 2007. This status facilitates the work of our staff, students and collaborators in the priority areas of skeletal tissue engineering, regenerative medicine and stem cell biology while ensuring the strictest adherence to the Human Tissue Act governing the use of human tissue in research.

Working with clinicians across the Institute and the Leeds Teaching Hospitals NHS Trust, the bank provides samples such as teeth, bone and stem cells. Access to samples is provided for our staff, students and collaborators (both academic and industrial) across the globe for use:

- to improve our understanding of skeletogenesis/odontogenesis
- to understand the mechanisms of tooth decay, erosion and wear
- to develop new ways of repairing teeth and restoring their function, including development of new materials for fillings
- using dental pulp and bone marrow to provide a source of adult stem cells for tissue regeneration and repair.

Benefits
The Skeletal Tissues Research Bank is an excellent research resource for our staff, students and collaborators while guaranteeing the highest standards of clinical governance and protection for patient donors.

Clinical governance and protection for patient donors of tissues and cells

WELMEC CENTRE OF EXCELLENCE IN MEDICAL ENGINEERING
FUNDED BY THE WELLCOME TRUST AND EPSRC*

The WELMEC Centre of Excellence in Medical Engineering brings together over 200 engineering, physical science, life science and medical researchers from the University of Leeds and Leeds Teaching Hospitals NHS Trust with clinicians and industrialists to deliver a series of healthcare impact challenges which are focused on improving the quality of life of older people.

A multi-million pound initiative, WELMEC focuses on providing engineering solutions for an ageing population with musculoskeletal and cardiovascular diseases for "50 active years after 50®. Involving scientists and clinicians from across the University, WELMEC integrates therapeutic interventions, diagnosis, enabling evaluation technologies and patient monitoring to address clinical and industrial challenges in medical and biological engineering for the ageing population.

WELMEC is addressing a series of healthcare impact challenges which are delivered through seven core research themes. Our principal involvement is in two themes: scaffolds and stem cell therapies. Professor Jennifer Kirkham leads the stem cell therapies theme in a strategy to use minimally manipulated autologous stem cells for regeneration of the skeletal tissues.

Impact and benefits
Being part of WELMEC has enabled our academics to work within interdisciplinary teams focused on specific clinical challenges related to degeneration of bones and teeth in an ageing population. This enhances our research capacity and capability in delivering innovative regenerative therapies and novel diagnostic methods.

Funders

Supported by
wellcome trust

EPSRC
Engineering and Physical Sciences Research Council

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INNOVATION AND KNOWLEDGE CENTRE (IKC) IN MEDICAL TECHNOLOGIES
FUNDED BY THE EPSRC†, BBSRC* AND TSB#

The Medical Technologies Innovation and Knowledge Centre is unique in bringing together businesses with world-class experts to accelerate the commercial development of new medical technology products and services.

Translation of Leeds Dental Institute’s research in biomaterials, biomineralisation and stem cell therapies for skeletal tissue regeneration and repair is both facilitated and expedited by the Institute’s membership of the Medical Technologies IKC. Under the leadership of Professor John Fisher, the IKC focuses on six innovation themes including scaffolds, stem cells, medical devices, diagnostics, medical imaging and enabling technologies. Institute staff have roles as Technology Leaders and Investigators in the IKC.

Impact and benefits
The Medical Technologies IKC has had a significant positive impact on our ability to deliver new therapies and devices in clinical dentistry. This is demonstrated by the recent collaboration between the School of Chemistry, The WELMEC Centre of Excellence in Medical Engineering and the Institute which brought together expertise in artificial scaffolds based around self-assembling peptides (SAPs) and in biomineralisation which led to the development of a novel treatment for early dental caries. This technology has now been licensed to a Swiss company, credentis ag, who will be marketing the product in 2012.

INSTITUTIONAL STRATEGIC PARTNERSHIPS

Responding to the recognition that global health problems in oral and musculoskeletal diseases require global solutions, we are committed to working with key strategic partner institutions to bring together expertise and skills to address these significant disease burdens.

Building on shared expertise and knowledge amongst our partners, we aim to work together to improve oral health outcomes in our own communities and across the globe.

Some of our strategic partnerships include formal memoranda of understanding with the Universities of Michigan (USA) and Osaka (Japan) as well as the establishment of a Joint Centre for Oral Health Sciences with the University of Nanjing (China).

We are founder members of the World Universities Network (WUN) for Oral Health Sciences, a network of 19 research intensive universities from six continents around the world committed to addressing global challenges in oral health.

Current themes include:
– challenging future dental care: Stem cell therapy for dental tissue engineering
– translational research in dentistry
– contemporary perspective on Chinese traditional medicine in oral care.

Impact and benefits
The development of our strategic partnerships has led to joint research through staff/student exchange resulting in publications, grant income and enhanced opportunities for dissemination of research advances to a global audience.
SKELETAL TISSUE REPAIR AND REGENERATION

Leeds Dental Institute and the Department of Biology at the University of York have a long-standing academic collaboration between materials scientists and biologists with a common interest in the repair/regeneration of hard tissues. We aim ultimately to apply the knowledge gained by working together to the development of therapies for patient benefit.

**Concept**
A focus of the Institute’s Biomaterials and Tissue Engineering Research Group, led by Professor David Wood, is the development of acellular scaffolds for the repair of bone and/or cartilage. At York, our collaborators in the Biomedical Tissue Research Group have been working on cell and molecular biology of skeletal tissues, including the characterisation of mesenchymal stem cells (MSCs) with a focus on osteogenesis. By bringing together these different but complementary skill-sets we aim to understand the nature of the interactions between model materials and mesenchymal stem cells at a genetic and molecular level.

**Impact and benefits**
Importantly, both groups have a focus on translating this underpinning knowledge into products for clinical use. In addition to gaining funding to carry out fundamental research, funding has been obtained to take material/cell constructs as far as pre-clinical testing.

Equally importantly, this collaboration has facilitated the training of several PhD students/Postdoctoral Research Assistants in a multidisciplinary way of working.

INTERNATIONAL CARIES DETECTION AND ASSESSMENT SYSTEM (ICDAS)

The ICDAS Foundation’s purpose is to progress the study and management of caries in a unified way. It involves caries experts worldwide who work along with representatives of international associations including the World Dental Federation, European Organisation for Caries Research and International Association for Dental Research. These experts come from various backgrounds including clinical practice, clinical research and dental public health.

This collaboration is a non-profit organisation which includes researchers from universities in the UK, Denmark, the USA and Columbia. Leeds Dental Institute is represented on the Board of Directors by Professor Gail Douglas.

**Concept**
ICDAS employs an evidence-based approach to classifying stages of the caries process and has developed an internationally accepted clinical scoring system for use in dental education, clinical practice, research and public health. It is designed to lead to better quality information to inform decisions about appropriate diagnosis, prognosis, and clinical management at both the individual and public health levels. The approach provides a framework to support and enable personalised total caries management for improved long term health outcomes through preventively orientated management of caries.

**Impact and benefits**
Importantly, both groups have a focus on translating this underpinning knowledge into products for clinical use. In addition to gaining funding to carry out fundamental research, funding has been obtained to take material/cell constructs as far as pre-clinical testing.

Equally importantly, this collaboration has facilitated the training of several PhD students/Postdoctoral Research Assistants in a multidisciplinary way of working.

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FILLING CHILDREN’S TEETH: INDICATED OR NOT (FiCTION)
FUNDED BY NIHR HTA*

The FiCTION research partnership includes co-applicants and collaborators from the majority of dental schools in the UK. The research project, led by Professor Gail Douglas in Leeds, Professor Janet Clarkson and Dr Nicola Innes in Dundee and Dr Anne Maguire in Newcastle, is a randomised controlled study of caries management strategies for the primary teeth.

Concept
Concepts of how best to manage caries in the primary dentition vary widely between dentists and educational establishments, which is a feature of the lack of robust evidence.

This £2.9 million multi-centre study in 50 general dental practices around the UK aims to establish whether one method is better than another in preventing toothache and infection in young children with caries. The three strategies being tested are:

- conventional management (fillings with the use of local anaesthetic and caries removal)
- biological management (sealing of decay from the oral environment with partial or no caries removal and usually no local anaesthetic)
- prevention only.

Impact and benefits
This partnership between UK dental schools is an important example of specialists and researchers uniting to answer an important clinical question. It is anticipated to have direct impact on guidelines for the way dental caries in the primary dentition is managed worldwide. Being a NIHR funded study it is likely to also impact on UK policy.

Answering clinical questions with evidence-based research

EFFECT OF SELF-ASSEMBLING PEPTIDES (SAPs)
IN TREATMENT OF WHITE SPOT CARIOUS LESIONS

In 2010 credentis ag was founded to commercialise the University of Leeds’ intellectual property in the field of SAPs for dental applications. The University holds significant equity share in the company. Successful ‘first in man’ trials were carried out in the Institute’s DenTCRU, and a CE mark approving clinical use of the product ‘Curodont™’ was awarded in January 2012.

Concept
The aim of the collaboration is to further develop the University’s innovative SAPs technology through to clinical delivery with credentis ag. This is being achieved at Leeds through jointly increasing capacity to develop the technology, expanding and improving the product range and assessing the products for clinical application.

The ultimate goal is to establish the technology globally, benefiting patients and generating revenue and jobs in the UK market.

Impact and benefits
Led by Professor Jennifer Kirkham, ‘Filling without Drilling’ peptide technology was co-invented and taken through to commercial partnership at Leeds Dental Institute, working in collaboration with Dr Amalia Aggeli in the Department of Chemistry and WELMEC.

Further funding was recently received through the University’s EPSRC-funded IKC in Medical Technologies, matched by support from credentis ag to provide screening capability based at the Institute for further product development. The project exemplifies the Institute’s strategy in translational research with basic research in biominalisation being used to inform therapeutic design for patient benefit.

www.credentis.com

*National Institute for Health Research Health Technology Assessment

Filling without drilling – translating basic sciences into new clinical therapy
IN SITU STUDIES WITH FLUORIDATED MILK
FUNDED BY THE BORROW FOUNDATION

The Borrow Foundation is committed to a programme for caries prevention through supporting milk fluoridation programmes for schools globally.

Many schools have a programme of making milk available to children. Addition of fluoride to milk is a novel way of delivering fluoride for prevention of dental caries especially in children who are considered ‘high caries risk’.

The Foundation has funded studies at Leeds Dental Institute to research the impact of milk fluoridation. Led by Professor Jack Toumba, these studies aim to further understand the role of fluoride delivered in milk and to investigate which concentrations of fluoride in milk demonstrate optimum beneficial effect for implementation in school milk fluoridation programmes.

Concept
A population-based study to research this question would be prohibitively difficult and expensive. Initially in vitro models were used to study varying concentrations of fluoride in milk. This was then translated to in situ models using enamel slabs taken from extracted human teeth to study the preventive effects of various concentrations in human volunteers using a randomised controlled study design.

Impact and benefits
This series of studies is an example of successful translation from in vitro to in situ studies in human volunteers. We are establishing optimum and safe levels of fluoride with maximum caries preventive effects in school children in collaboration with The Borrow Foundation. This will subsequently inform the Foundation’s global programme supporting milk fluoridation for schools.

ADVANCING THE GENETICS OF ENAMEL DEVELOPMENTAL ABNORMALITIES (AGEnDA)
FUNDED BY THE WELLCOME TRUST

AGEnDA brings together researchers from the University of Leeds and clinicians from the Leeds Teaching Hospitals NHS Trust to work with an associated network of researchers and clinicians around the world.

Dr Alan Mighell is leading this partnership which aims to improve insight into the basis of developmental enamel abnormalities. This will lead to an improved understanding of biominerisation and translation of this new knowledge to clinical care in different ways.

Concept
The partnership involves the full cycle of ascertainment and recruitment of families, gene discovery and feedback to those affected through dissemination of findings. Families with Mendelian-inherited enamel developmental abnormalities including Amelogenesis Imperfecta are investigated via cutting-edge genetics approaches in the University of Leeds Institute of Molecular Medicine. Preliminary functional data related to gene discovery is obtained in multidisciplinary partnerships.

Impact and benefits
In a short period of time the partnership gained novel insights into gene function critical to biominerisation and in selected families, associated retinal degeneration, immunological function, muscle formation or renal impairment. These discoveries translate with global relevance to the care of those affected. They also open up new areas of biominerisation research that inform the development of new therapies with the potential to promote biominerisation not only in teeth but also in other settings.
Scientists and clinicians in Leeds Dental Institute and the Department of Computing at the Faculty of Engineering are collaborating to develop preventive and therapeutic strategies to combat biofilm infections.

Funded by the Biomedical and Health Research Centre, a Senior Translational Research Fellow Dr David Head is working with the Institute on \textit{in vivo} and \textit{in vitro} data and applying computational analysis and modelling approaches to biofilms in this collaboration led in the Institute by Professor Deirdre Devine and Dr Alan Mighell.

**Concept**
Biofilm structure, organisation, dynamics and host responses require modelling at every level of organisation. Crucial to understanding such systems are detailed models of the cellular and environmental constraints of complex multi-species interactions within the dynamic polymer mesh that comprises the biofilm.

Novel imaging, complemented by genetic data, makes the modelling of such systems particularly timely but cutting edge modelling tools are essential to ensure progress and clinical relevance. Oral biofilms are the best characterised and accessible complex human biofilms, presenting opportunities for understanding biofilms of broader relevance.

**Impact and benefits**
Using \textit{in vitro}, \textit{in situ} and clinical biofilms, the study is developing models based on data generated from dental biofilms from health and disease. There will be scope for studies with translational endpoints in treating or preventing infection, and also relevant to regenerative therapies and implants.

**Using mathematics to combat biofilm infections**

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**ResusPod® Limited**

ResusPod® Limited is a partnership between clinical academics at Leeds Dental Institute, Medipex Limited and the University of Leeds. ResusPod® was the initiative of Dr Kate Taylor and Dr Julie Burke from Leeds Dental Institute, who developed the concept of ‘complete compliance’ with national guidelines relating to the management of medical emergencies in dental practice.

**Concept**
A kit, along with specially designed algorithms, has been specifically manufactured to make the management of medical emergencies as stress-free as possible while leading to optimal outcomes for patients. ResusPod®, a spin-out company, was formed to provide easy access to all the necessary drugs, equipment and training to successfully manage common medical emergencies in primary dental care.

**Impact and benefits**
ResusPod® endeavours to be the international ‘Gold Standard’ for the management of medical emergencies in dental practice thus providing an additional strand in the Institute’s strive for clinical excellence.

The partnership between Medipex Limited (the NHS innovation hub for the Yorkshire and Humber region) and the University of Leeds brings together strengths in the commercial, clinical and academic fields, which has significantly helped to develop the infrastructure of ResusPod®.

In 2011, the company secured private investment, brought in an experienced management team and was nominated in the 2011 Medipex NHS Innovation Awards.

**Developing a new product from concept to use in practice**

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www.resuspod.com
POSTGRADUATE RESEARCH DEGREES

The Leeds Dental Institute’s internationally renowned scholars and state-of-the-art facilities provide an ideal research environment in which to undertake postgraduate studies.

Student support and personal and professional development are key elements in our postgraduate programmes. The University of Leeds is committed to providing a setting in which our postgraduate students can acquire research skills and knowledge; develop a wide range of attributes; prepare for academic or industrial careers and also realise personal/professional ambitions.

Research programmes at the Institute cover a wide range of clinical and basic science disciplines with seamless multidisciplinary integration across all areas. We offer research degrees at PhD, MPhil and MSc levels.

Postgraduates have the choice of studying for their PhD by following the classic route by research alone. Alternatively, there are the innovative Integrated PhD and Professional Doctorate programmes – research degrees with taught components. These programmes are most suitable for clinicians as they offer advanced clinical training and education combined with high level research activity.

Whichever career path you choose, a research degree from the University of Leeds Dental Institute is the ideal springboard to realise your aspirations.

For more information on postgraduate research degrees, contact:
Faculty of Medicine and Health Graduate School
T: +44 (0)113 343 7497
E: fmhgrad@leeds.ac.uk
www.leeds.ac.uk/info/20023/research

CONTACT US

If you would like to find out more about our research, partnerships and collaborations or how you can work with Leeds Dental Institute, please contact:

Ruth Kayman
Research Administrator
Leeds Dental Institute
University of Leeds
Clarendon Way
Leeds LS2 9LU, UK
T: +44 (0)113 343 6159
E: R.B.Kayman@leeds.ac.uk
www.leeds.ac.uk/dental/research