

Clinical and translational research

Programme leader: Professor Warwick Duncan

Te Kaupeka Pūniho, New Zealand's National Centre for Dentistry, is the centre of excellence in New Zealand for clinical and translational research in dentistry and oral health.

The Clinical and Translational Research programme groups together researchers and projects whose objective is to enhance care and achieve better outcomes for our patients. There is considerable overlap with other research programmes, particularly with respect to the translation from benchtop, *in vitro* and preclinical animal research into development of commercially-viable products or improvements in clinical practice.

Current projects range from clinical trials conducted within the school and out in the community, of new products or modified treatment protocols, to development of new therapeutic agents and devices from benchtop through initial *in vitro* and preclinical animal trials with the objective of phase 1 clinical trials, to surveys conducted within the school or in the community regarding the techniques employed in clinical dental practice and their outcomes. Funding for this work ranges across contestable research grants, commercial sponsorship and contract research, and includes both researcher-initiated investigations and research driven by manufacturers of dental products.

Key personnel

Staff

Professor Warwick Duncan
Professor Mauro Farella
Professor Paul Brunton
Professor Darryl Tong
A/Prof Mo'men Atieh
A/Prof Nick Chandler
A/Prof Neil Waddell
A/Prof Vincent Bennani
A/Prof Andrew Tawse-Smith
A/Prof Lyndie Foster-Page
A/Prof Dawn Coates
Dr Sunyoung Ma
Dr Trudy Milne
Dr Carolina Loch
Dr Joanne Choi
Dr Gemma Cotton
Dr Tanmoy Bhattacharjee
Dr Jithendra Ratnayake
Dorothy Boyd

ARCH dental practice-based research network

Dr Lara Friedlander
Suzanne Hanlin

Postgraduate students

Tatiana Tkatchenko
Anumala Ram
Saeideh Nobakht
Siddharth Kothari
Rachel Farrar (Walters)
Christina Gee
Dina Abdelmoneim
Asrar Elahi

The major part of Clinical and Translational Research involves diverse projects undertaken by the staff, postgraduate and undergraduate students of the School. Additionally, work has continued on the development of our dental practice-based research network, Applied Research through Clinicians' Hands (ARCH), with a view towards fostering research conducted outside the School by and for New Zealand dental practitioners, with the support of Dental faculty staff.



Clinical facilities within the new Clinical Services Building.

Current research projects

'Silverbone' project

Professor Warwick Duncan (right) is working on two significant advances in dental technology that could cut the cost of treatments, improve general health and involve New Zealand's agricultural sector with a new high-value product.

“As a periodontist I treat gum disease, take teeth out and graft bone to be able to implant new teeth as necessary. But as mouths are relatively filthy places, infections can occur and if grafts don't work you can actually lose bone. To a certain extent we can manage that with antibiotics, but we're trying to reduce their use.”

The drive for improvement sees Professor Duncan heading an international and interdisciplinary team including Chemistry's Dr Carla Meledandri and Dr Nina Molteno from Molteno Ophthalmic Ltd, a Dunedin manufacturer specialising in bone graft materials.

His team has come up with a new bone-based grafting material, Silverbone, that is robust enough for dental work and contains silver with anti-bacterial properties.

“It would be nice not to have animal testing phases, but we have to show it is safe and promotes new, healthy bone growth. So now we are working in the laboratory to create something that will be superior and save money and be sold and used in dental procedures every day.”

'UltraD3' project

Professor Duncan is also working on developing UltraD3 – a miniaturised ultrasound device to help with dental diagnosis – with Callaghan Innovation engineer Paul Harris and a world-leading team with capabilities in dental research, ultrasonics, electronics and materials science.

“We're trying to make a new tool to assist diagnosis of gum disease around teeth and dental implants. When Paul first asked how I diagnose gum disease I told him I poked it with a stick. It's actually called a periodontal probe, but it's much the same thing. We're aiming to do better than that.”

The diagnostic technique hasn't changed for a century, so it's high time for an improvement, says Duncan.

Gum disease affects one in three adult New Zealanders and is the world's sixth most prevalent condition, with strong links to diseases with high morbidity and mortality. Early intervention should reduce both discomfort and late stage treatments, save money and improve health.

Ultrasound is used for many conditions, such as in breast cancer diagnostics, where it measures changes in tissue stiffness.

“The challenge is to make the device small enough to fit comfortably in the mouth and accurate enough dealing with very small amounts of tissue. We're now on version three and we're getting close. It should be a very useful diagnostic device and almost certainly will be able to be used in other ways in the future.



Collaborations

Within the University of Otago

Department of Applied Sciences, Clothing & Textile Sciences
Department of Geology
Department of Preventive & Social Medicine, Dunedin
School of Medicine
Department of Physics Department of Chemistry School of Pharmacy

Other Universities

Department of Mechanical Engineering, University of Auckland
MedTech CoRE (Centre for Research Excellence), New Zealand
University of Zürich, Switzerland

Companies and other entities

Aroa Biosurgery Ltd
Callaghan Innovation
Geistlich Pharma (Switzerland)
Ivoclar International (Liechtenstein)
Molteno Ophthalmic Ltd
Resorba Medical GmbH (Germany)
Southern Implants Ltd (South Africa)
Zimmer Biomet 3i (United States of America)

Key funding successes

\$41,376. University of Auckland - MedTech CoRE. Needle free injections (Paul Brunton, Carolina Loch Santos da Silva)

\$36,486. University of Otago Research Grant. Cattle bone in Root Canal therapy? Development of a novel root canal medicament from New Zealand-sourced waste bovine bone (Jithendra Ratnayake, Peter Cathro, Joanne Choi, George Dias)

\$43,930. University of Otago Research Grant. Regeneration of dental pulp tissue using a novel hybrid biomaterial (Azam Ali, Lara Friedlander, Karl Lyons)

\$44,000. Otago Innovation Limited. Initial formulation of manuka oil for delivery on collagen sheet devices (Warwick Duncan, Gemma Cotton)

\$119,749. New Zealand Lottery Grants Board. Ultrasound cancer screening device and contrast agent project (Warwick Duncan, Tanmoy Bhattacharjee)

\$29,488. University of Otago Research Grant. Aerosol generation level by different dental high-speed handpieces (Joanne Choi, Jane Choi, Susan Moffat, Neil Waddell)

Developing white shell crowns for Hall technique use

Dental decay is the most common chronic childhood disease in New Zealand. Treatment is often delayed, for many reasons – including fear and cost – which only serves to exacerbate the severity of the problem; consequently, increasing the cost and fear associated.

Decay also has a greater impact on certain subsets of society, such as a Maori and Pasifika, as well as children from lower socioeconomic environments. The impact is further compounded by the significant impact restorative dental care has on the public health system.

Dr Joanne Choi (right) and colleagues from the SJWRI's Clinical and Translational Research programme are looking to improve upon a novel technique that could reduce some of the anxiety associated with going to the dentist. Known as the Hall Technique, this method allows for children to avoid the 'drill and fill' of conventional dental care. Instead of the usual invasive measures, a stainless-steel cap is placed on the decaying tooth without any need for anaesthetic or drilling. The crown seals off the decaying tooth, preventing further tooth decay.

One downside to the Hall Technique is the crown's aesthetically unpleasant look. The appearance of the crown represents a very real obstacle to its use. Dr Choi and her team are developing an alternative crown to stainless steel; one that is tooth coloured and hence less visible as different from the surrounding teeth.

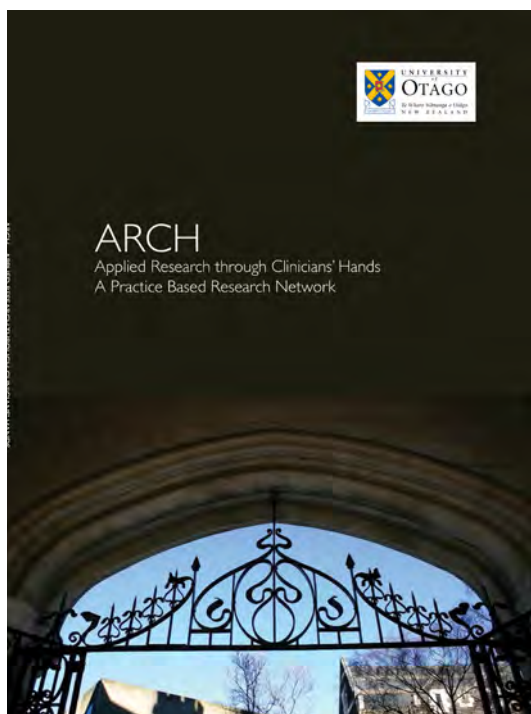
Producing a tooth-coloured cap is not as easy as it sounds; several attempts have been made, only to come up against similar issues around the malleability and plasticity required for the Hall Technique. Using a variety of materials, representing different required functionalities, Dr Choi and her team hope to create a strong crown that lasts.

The team plan to translate their lab-based research into a clinical trial and, ultimately, to make the tooth-coloured crowns available for use in all dental practices.

Other clinical and translational research projects

Novel therapeutic agents

- Silver nanoparticles (Silverbone project, details on previous page) – *in vitro* and preclinical animal trial
- Optimisation of MoaBone® natural hydroxyapatite xenograft (with Molteno® Ophthalmic Ltd.) (*in vitro* and preclinical)
- Manuka honey as an antibacterial agent (*in vitro* and clinical trial)
- Manuka oil as an antibacterial agent (*in vitro*)
- Regenerative membrane for alveolar ridge preservation (with Aroa Biosurgery Ltd.) – preclinical trial
- Gel-loaded lactoferrin for oral bone grafting (with Auckland University and CReaTE Research Group) – *in vitro* and preclinical animal trial
- Novel grafting materials for sinus lift therapy (preclinical animal trial)
- Healing mechanisms in stem-cell driven regeneration of deer antler



Novel therapeutic approaches

- Hall technique for childhood caries – clinical trial
- Development of white crowns for Hall technique (details above) – *in vitro*
- Vital tooth bleaching - clinical trial
- Orthodontic tipping and bodily movement of premolars in a sheep model – preclinical trial

Implant therapy

- Titanium-zirconium narrow dental implants for replacing single posterior missing teeth - clinical trial
- Dental implant abutment-interface and marginal bone loss - preclinical animal trial

Diagnostics

- Ultrasonic devices for early diagnosis of periodontal diseases (UltraD3 project, details on previous page) – benchtop, preclinical animal trial, clinical trial