



UNIVERSITY OF OTAGO
FACULTY OF DENTISTRY
**SIR JOHN WALSH
RESEARCH INSTITUTE**
TE POKAPŪ RAKAHAU OTĀ JOHN WALSH

Research Highlights

2017-2018



1907

University of Otago School of Dentistry founded

The original School of Dentistry was housed at 80 Union Street, a category 1 registered heritage building now used as the University Staff Club.

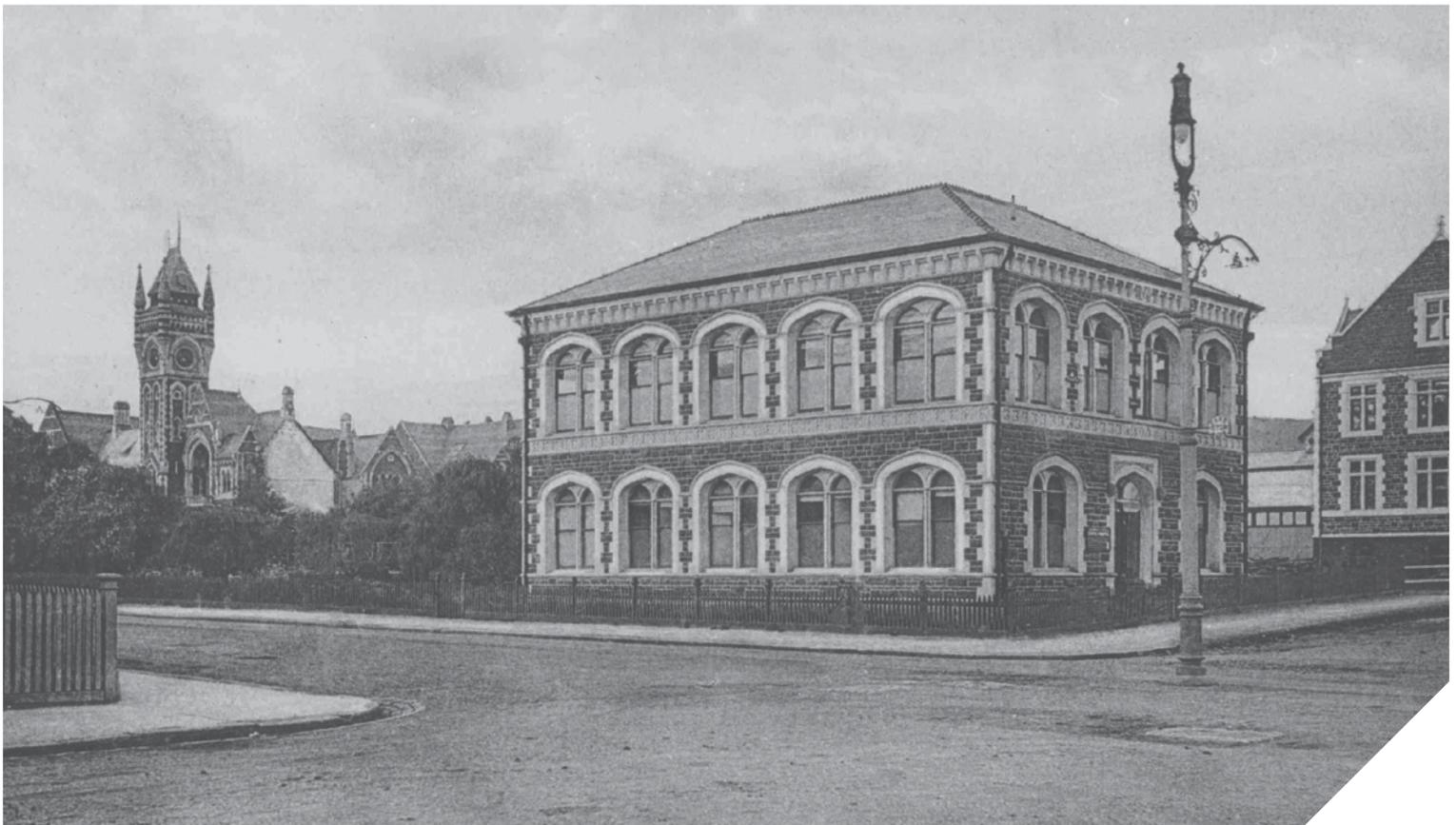


Table of contents

About the Sir John Walsh Research Institute	3
Introduction from our Director, Professor Richard Cannon	4
Our highlights	
Publications and research funding summary	6
Dentistry redevelopment programme	8
New Auckland dental facility	14
Te Kāika health hub opens	16
World ranking successes	17
Staff awards and achievements	18
SJWRI Research Day	22
SJWRI Awards	28
Research funding successes	37
Student awards and achievements	42
Conferences and outreach activities	45
Stories from our research	50
Our programmes	
Biomechanics and Oral Implantology	58
Clinical and Translational Research	63
Craniofacial Research	68
Dental Education Research	73
Dental Epidemiology and Public Health	78
Molecular Microbiology	82
Oral and Molecular Immunopathology	87
Who was Sir John Walsh?	93

We hope you enjoy these Research Highlights from the Sir John Walsh Research Institute, a snapshot of our research activities and achievements for the 2017-18 period. If you would like more detail, our full Research Report of the Sir John Walsh Research Institute 2017-2018 is available, including further details on our research programmes, activities and achievements, and profiles of researchers. More information is also available from our website www.otago.ac.nz/sjwri.

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Research Highlights from the Sir John Walsh Research Institute 2017-18 was compiled by Dr James Smith, with thanks to Professor Richard Cannon and the staff and students of the Sir John Walsh Research Institute.

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Cover image: Artist's impression of the new University of Otago dental teaching facility and patient treatment clinic at the Counties Manukau DHB SuperClinic site in South Auckland, currently under construction. Image courtesy Jasmx.

Sir John Walsh Research Institute

The Sir John Walsh Research Institute (SJWRI) advances research and increases knowledge for the improvement of oral health in New Zealand, and provides a national focus for dental research.

The Institute's innovative, future-focused, interconnected research programmes cover the spectrum of oral health research, from the molecular, through biological systems to the health of populations.

The SJWRI is integral to New Zealand's only Faculty of Dentistry, ranked in the top 30 worldwide in 2017-18, and its members have well-established productive collaborations across the University and with other institutions in New Zealand and worldwide.

Our mission is to undertake research that underpins our teaching and clinical practice, and that translates discoveries into measurable health improvements for all New Zealanders.

The Institute is named after Sir John Walsh, Dean of Dentistry from 1946 to 1971, a strong advocate for research in dentistry and oral health.

Mission

- Advance research and increase knowledge for the improvement of oral health in New Zealand
- Support and represent the oral health research community in New Zealand
- Facilitate the communication and application of our research findings for the benefit of oral and general health worldwide

Values

- Research for Public Benefit - we are committed to carrying out research that leads to new methods for disease prevention, diagnosis, and treatment, in order to improve people's oral and general health
- Excellence - we are committed to the pursuit of excellence in research for the development of dental care to enhance the oral health of the public
- Integrity - we are committed to integrity, honesty and consistently high standards in research and in all our interactions, both internally and externally
- Accountability - we believe that we are accountable for our actions and we are prepared to submit ourselves to appropriate scrutiny
- Equity - we will ensure that our policies and practices do not discriminate unfairly or lead to other forms of unfair treatment

Introduction from our Director



The last two years at the Sir John Walsh Research Institute (SJWRI) have been a combination of stability and change. The SJWRI has continued to undertake cutting edge research within its seven research programmes: Biomechanics and Oral Implantology, Clinical and Translational Research, Craniofacial Research, Dental Education Research, Dental Epidemiology and Public Health Research, Molecular Microbiology Research, and Oral Molecular and Immunopathology Research. Details of the achievements within these programmes can be found in this research report. The Institute has also continued to run very successful annual Research Days that showcase our research and build collaborations across New Zealand and internationally.

We have continued to make significant contributions to the International Association for Dental Research (IADR) Australia New Zealand (ANZ) Division and IADR General Sessions. Professor Karl Lyons is currently the Vice-President of the ANZ Division, and Associate Professor Jonathan Broadbent is President of the New Zealand Section. The SJWRI has had booths promoting both our research and the Faculty of Dentistry at the IADR General Sessions in San Francisco in 2017 and London in 2018, which proved to be very popular. Dr Li Mei was awarded the ANZ IADR Oral Biology Award at the Divisional meeting in Adelaide in 2017. At the same meeting, Dr Kai Chun Li was awarded the ANZ IADR Joan Chong Award in Dental Materials, and Dr Carolina Loch was awarded the ANZ IADR Oral Biology Award in 2018. Professor Murray Thomson was awarded the IADR Robin Heath Award for the most downloaded paper in the journal *Gerodontology* during the previous five years, at the 96th General Session of the IADR in 2018.

The Institute has continued its outreach activities. As a result of our *Making a good impression: from fossils to false teeth* outreach programme in local primary and intermediate schools, Dr Loch was approached by Te Kura Kaupapa Māori o Ōtepoti for assistance to run a dental science programme in their Kura looking at the effect of sugar in the diet. A team from the SJWRI and the Department of Human Nutrition helped run monthly sessions where the students undertook experiments and activities investigating sugar and acids in their diet and the effect of these on their teeth and bodies.

The last two years have also been a period of change. The phrase “the only thing that is constant is change” may seem very topical, but it is attributed to Heraclitus of Ephesus who lived from 535 to 475 BCE, so change is nothing new. The rate of change at present, however, is rapid and the scope of the change is large. There are changes in the expectations of society, and funding agencies, on scientists in terms of outcomes and impact from research. Furthermore, funding for research is becoming increasingly difficult to secure.

The Institute has responded to these changes. We have established contestable PhD start up grants and Sir Thomas Sidey SJWRI PhD scholarships to support postgraduate research. The institute has recently awarded three research grants generously sponsored by Colgate Palmolive, and we hope to be able to repeat this annually. The SJWRI has worked with the New Zealand Dental Association (NZDA) to contribute a research session at the Annual NZDA conference designed at sharing our research results with the dental profession.

There are also changes afoot in the Faculty of Dentistry. We are in the middle of a building programme to replace the dental clinics, the research laboratories, and establish a dental facility in Auckland. This has involved decanting offices and laboratories from the Walsh building to various locations around the University of Otago campus. While these changes have caused some disruption to research there are also benefits – the fact that our laboratories have been decanted to the University of Otago Centre for Innovation and the Department of Biochemistry, is increasing our ‘outreach’ and may lead to new interdisciplinary collaborations. The Faculty of Dentistry is currently in the process of moving into a new state-of-the-art Clinical Services Building which will be able to support and extend our clinical research. There is no progress without change, and we are excited by the prospect of new facilities enabling the SJWRI to take its research to the next level.

Professor Richard Cannon

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Our highlights

1926

Marples Building

To accommodate growth, the School of Dentistry relocates to a new purpose-built building at 360 Great King Street (now known as the Marples Building – Department of Zoology).



Publications and funding summary

Publications summary

Category	2017	2018	Total
Edited Book - Research	1		1
Chapter in Book - Research	9	2	11
Chapter in Book - Other	2		2
Journal - Research Article	93	111	204
Journal - Research Other	14	20	34
Journal - Professional & Other Non-Research Articles	7	2	9
Conference Contribution - Published proceedings: Full paper		2	2
Conference Contribution - Published proceedings: Abstract	75	37	112
Conference Contribution - Poster Presentation (not in published proceedings)	3	3	6
Conference Contribution - Verbal presentation and other Conference outputs	24	8	32
Other Research Output	1	5	6
Awarded Doctoral Degree - Staff	2	5	7
Awarded Masters Degree - Staff	1		1
Total, Sir John Walsh Research Institute/Faculty of Dentistry	232	195	427

To avoid double counting, unique publication counts are used when a publication has authorship from more than one department; e.g. for a publication with authors from more than one department, each department's contribution is allocated proportionally. Publications data courtesy Dr Donna Hendry, Publications Office.

Postgraduate degree completions

Degree	2017	2018	Total
Doctor of Philosophy (PhD)	2	7	9
Doctor of Clinical Dentistry (DClinDent)	18	12	30
Master of Community Dentistry (MComDent)	4		4
Master of Dentistry (MDent)	2	2	4
Master of Dental Surgery (MDS)		1	1
Master of Oral Health (MOH)		1	1
Postgraduate Diploma in Clinical Dental Technology (PGDipCDTech)	21	9	30
Postgraduate Diploma in Clinical Dentistry (PGDipClinDent)	3	5	8
Postgraduate Diploma in Dental Therapy (PGDipDentTher)	1		1
Total, Sir John Walsh Research Institute/Faculty of Dentistry	51	37	88

Data are for all postgraduate degree completions between 1 Jan 2017 and 31 Dec 2018, for which the SJWRI or other departments within the Faculty of Dentistry were listed as host department. Data courtesy Karen O'Neil, Dentistry.

Research funding summary

Funder/Contracting body	2017	2018	Total
Aroa Biosurgery Ltd	\$264,460		\$264,460
Australian and New Zealand Association of Oral and Maxillofacial Surgeons (ANZAOMS) Research and Education Foundation Inc.		\$2,725	\$2,725
Australasian Council of Dental Schools		\$54,000	\$54,000
BLIS Technologies Limited	\$3,981	\$5,000	\$8,981
Cure Kids	\$26,800	\$49,458	\$76,258
Deer Industry New Zealand	\$150,000		\$150,000
Dentalife Australia Pty Ltd	\$13,425		\$13,425
Downie Stewart (Fuller Trust)	\$13,875	\$33,000	\$46,875
Health Research Council of NZ (HRC)	\$198,588*		\$198,588*
HiTem Co. Ltd	\$9,132		\$9,132
ITI International Team for Implantology		\$242,004	\$242,004
Kiwi Innovation Network Limited		\$20,000	\$20,000
Maurice and Phyllis Paykel Trust		\$10,000	\$10,000
MedTech CoRE	\$25,000	\$91,887	\$116,887
Ministry of Health Oral Health Research Fund	\$9,970	\$53,093	\$63,063
New Zealand Dental Association Central Districts Branch	\$3,000	\$3,000	\$6,000
New Zealand Dental Research Foundation	\$106,068	\$133,432	\$239,500
New Zealand Institute of Dental Technologists	\$4,668	\$4,930	\$9,598
New Zealand Lottery Grants Board	\$166,482		\$166,482
Otago Innovation Limited	\$149,997		\$149,997
Otago Medical Research Foundation	\$15,000		\$15,000
Otago Museum Trust Board	\$13,700		\$13,700
Royal Society of New Zealand		\$80,000	\$80,000
Silventum Limited		\$17,489	\$17,489
University of Otago Research Grants	\$74,680	\$191,589	\$266,269
University of Michigan	\$34,326		\$34,326
Total	\$1,283,152	\$991,607	\$2,274,759

Figures are in New Zealand dollars and represent all external research funding contracts commencing between 1 Jan 2017 and 31 Dec 2018, led by Principal or First Named Investigators from the Sir John Walsh Research Institute and Faculty of Dentistry. This does not reflect contracts beginning in earlier years which ran through the 2017-18 period. *This grant was declined post-award due to the departure of the PI.

Research funding data courtesy Dr John Milnes and Lorraine Harris, Research and Enterprise Office.

A full listing of research publications, research funding and postgraduate degree completions from the SJWRI and Faculty of Dentistry for the 2017-18 period is available in our *SJWRI Research Report 2017-2018*.

Dentistry redevelopment project

Artist's impression of the exterior of the new School of Dentistry buildings. Courtesy Jasmx.



The Faculty of Dentistry and the Dental School Redevelopment Project Team wishes to thank everyone for their patience while New Zealand's only dental faculty is becoming the most technologically advanced in Australasia – providing Otago with world-class research and teaching facilities for its world-leading academics, and the best environment possible for students and patients.

The Faculty carries out about 76,000 treatments on the public from around the lower South Island annually, hosts the Sir John Walsh Research Institute, and caters for undergraduate and postgraduate programmes in dentistry, oral health and dental technology. The University has been home to New Zealand's only Faculty of Dentistry since 1907, but the faculty has been in its current building for 54 years so needed to move with the times. The redeveloped dental school precinct will herald a new era of development in dentistry, and will lead Australasia in patient management and technology.

Construction of the new 8,000m² Clinical Services Building commenced early in 2017 behind the Walsh Building in Great King Street. The CSB will house specialty and teaching clinics, the Primary Care Unit, radiography, and surgical suites. It will have 214 new dental chairs, 61 more than now – and patient records will be digital, and accessed on computers at the chairside, instead of using paper files.

After the Clinical Services Building is finished in mid-2019, the Walsh Building's remaining clinical areas will relocate to the new facility. Then, the 10,000m² Walsh Building, opened in 1961 and listed as a category 1 historic place, will be refurbished. Once completed in 2020, the refurbished Walsh building will house the Sir John Walsh Research Institute, administrative support for the faculty, the management team, academic and support staff, research and teaching laboratories.

The two buildings will be linked by an 1,800m² atrium, which will be the 'heart' of the facility, used by patients, students and staff.

The Faculty's \$130 million dollar extreme makeover also includes refurbishment of the Blue Lecture Theatre, adjoining the Walsh Building in Frederick Street. This part of the project was completed in early 2018.



CSB construction progress, November 2017.
Courtesy Fiona McDonald.

Moving on up: the Dental School decant

Redevelopment of the Walsh Building required the decanting of staff, students and clinical and research facilities to other locations across campus during 2017-18.

The first stage of the decant took place in 2015-16, in which the Walsh Building's former West Wing was evacuated ahead of its demolition in order to make space for the new CSB. About 40 staff and the Faculty's Simulation Laboratory – where students develop their skills on sophisticated artificial heads – moved from the Walsh Building to the Dunedin Hospital Children's Pavilion.

The second stage of the Dentistry decant – which took place between November 2017 and the end of 2018 - involved 16 individual moves, and moved almost 300 people and five laboratories to nine locations around the University of Otago's Dunedin campus. The decant was particularly complex because the campus is already packed tight with people and facilities; just finding spaces for everyone took about 18 months. The decant project involved construction of laboratories for histology, clinical technology, and biomaterials and forensic research in the Centre for Innovation (Cfi), on the University of Otago's main campus. These laboratories moved into their temporary premises in the Cfi at the end of November 2017, with staff and students moving into nearby office space in 533 Castle St.

Other facilities and staff also shifted from the Walsh Building in mid 2018 to various locations around campus, including the Childrens' Pavilion and the Jamieson Building (formerly home to the University's Human Resources Division). The Dental School Project Team moved from the Walsh Building to 71 Frederick St, formerly the base for the Sir John Walsh Research Institute which moved to the Jamieson Building. The Molecular Biosciences Laboratory moved into the ground floor of the Department of Biochemistry building on Cumberland Street, while Dental Technology teaching laboratories moved to a specialist laboratory portacom next to the Higher Education Development Centre (HEDC) in Union Street. All will return to the completed Walsh Building in early 2020.



CSB construction, 2017-18

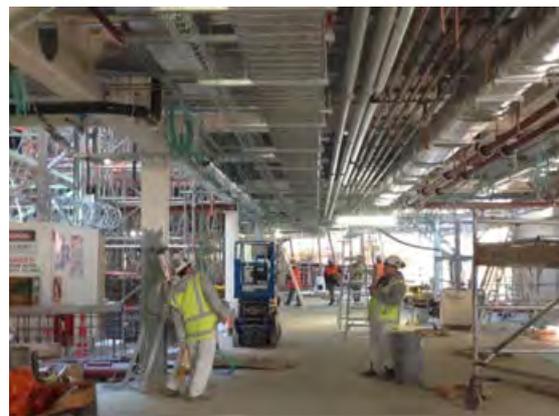
Left: Construction progress, Dec 2017.

Middle row, left: Progress, early 2018.

Middle row, right: Fitout inside the new CSB as of June 2018, where steel wall partitions had gone up and pipes, ducting and trays for electric cables had also been installed.

Bottom: By June 2018 the roof was finished on the new CSB – a milestone marked by a function for Faculty staff and project team members - and the floors had been poured on all four levels. A crane had started to fit glass in the windows on the south and western façades.

Photographs courtesy Fiona McDonald and Beth Chisholm, Building Project Team.



On track to open in early 2020, the completed Dental School Redevelopment will feature:

- New operating theatres and surgical suites that will cater for developments in surgical specialties
- 214 new high-specification dental chairs, 61 more than in the previous Dental School building
- Digital patient records that can be accessed on computers at the chairside instead of paper files
- Digital imaging that will reduce x-ray exposure and handling of potentially hazardous chemicals
- Digital imaging technologies that will improve support for researchers, particularly for investigations involving sleep apnoea and movement of the jaw
- Tutorial spaces linked to patient treatment areas, with integrated technology to enrich the learning experience
- Uniting the research laboratories of the SJWRI into one area within the redeveloped Walsh Building; currently, staff and students are divided among many small laboratories across campus
- Academic offices brought together on the floor below the laboratories, allowing ready access to clinics and research facilities



Artist's impressions of the interior of the new Clinical Services Building and the Atrium linking it to the redeveloped Walsh Building.



Clinical Services Building completion, mid 2019

Below: External view of the new Clinical Services Building.

Opposite page, top row: installation of dental chairs in the clinic spaces on the second floor. Middle left: orthodontics clinics. Middle right: patient waiting room, first floor. Bottom row: view of the atrium space between the CSB and the Walsh Building, which is now being redeveloped.





New Auckland dental facility



Artist's impression of the new University of Otago dental teaching facility and patient treatment clinic in South Auckland, construction of which began in late 2018. Courtesy Jasmx.

Otago to build new dental facility in South Auckland

The University of Otago is building a dental teaching facility and patient treatment clinic in South Auckland to help meet high health needs, while providing students with wide-ranging learning opportunities in a diverse community.

The \$28.2 million, two-storey, 32-chair building will be built upon land owned by the Counties Manukau District Health Board at its Manukau Super Clinic on Great South Road.

Announced in August 2018, construction began in December 2018 and the project is on target for completion before the start of the academic year in 2020.

University of Otago Vice-Chancellor Professor Harlene Hayne says by making a real difference to people's lives and a community's health and well-being, the University will be living its strategic commitment to providing for the national good and improving lives.

The University is also committed to helping develop students into good citizens and this project will create a community-focused experience that involves thoughtful giving and service, Professor Hayne says.

Pro-Vice-Chancellor of the Division of Health Sciences and Dean of the Faculty of Dentistry from 2016 to 2018, Professor Paul Brunton, says the

project is a win-win situation for both the local community and the University.

"Patients are contributing to the education of the country's future dentists and, in exchange, they have access to high-quality dental care."

The Manukau dental teaching facility and patient treatment clinic will follow the long-standing social contract model operated successfully in Dunedin, where patients receive treatment provided by students under supervision at a highly accessible cost, Professor Brunton says.

Forty-eight final-year Bachelor of Dental Surgery students will be assigned to the Manukau facility at any one time.

Professor Brunton says treating people in Manukau is only possible because of a much-valued relationship with the CMDHB, which led to the two institutions signing a Memorandum of Understanding in November 2014 so they could work together to achieve mutual goals.



Businessman and philanthropist Graeme Hart receiving his Honorary Doctor of Commerce in December 2017 from John Ward, then University of Otago Chancellor.

The Counties Manukau District Health Board provides services to 11 per cent of New Zealand's population, including 12 per cent of New Zealand's Māori, 37 per cent of New Zealand's Pacific people, and 21 per cent of New Zealand's Asian people.

"The new facility will not only provide students with diverse practical learning opportunities but also increase their understanding of people from a wide range of backgrounds," Professor Brunton says.

The project will strengthen relationships and partnerships with Māori and Pacific communities as well, based on mutually beneficial goals incorporating patient care, research and education.

Not only will the Faculty of Dentistry regularly consult the community to find out what it needs from the clinics then work to deliver that, the Faculty will also provide a wide range of outreach activities.

Having an Auckland base in an area home to a large number of oral healthcare professionals will also make it easier for them to access continuing education opportunities.

The facility could help meet international demand for upskilling dentists as well, due to Auckland's accessibility.

History-making donation secures future of Auckland dental facility

The University of Otago is grateful to internationally renowned businessman and philanthropist Graeme Hart and his wife Robyn for their generous donation of \$10 million which will help develop a new dental teaching facility in South Auckland.

The donation is the most significant in the University's 150 year history, and University of Otago Foundation Trust Chair John Ward says the University is indebted to Mr and Mrs Hart.

"We are immensely grateful to Graeme and the Hart family for their generosity," Mr Ward says.

"This funding will make a significant contribution to the development of a new dental teaching facility which will not only provide students with diverse practical learning opportunities, but will also provide dental care for the local diverse communities at a highly accessible cost."

Mr Hart, who lives in Auckland, is considered one of the most successful and generous businessmen to operate both within New Zealand and on a global scale. Last December he was awarded an Honorary Doctor of Commerce degree by the University, in recognition of his contribution to the business sector and philanthropy by supporting education and children's health.

Mr Hart is pleased the donation will help support both the University and the South Auckland community. "We are delighted to be able to assist our University in providing a Dental School that will meet the needs of lower socio-economic groups. We are very pleased that the youth and young children of this region will benefit from this facility," Mr Hart says.

Mr Hart notes that he and family members are very thankful for having had the opportunity to study at the University of Otago, to have experienced life on the University of Otago campus, and to meet individuals there with global reach. He considers that undertaking a Master of Business Administration there was one of the most pivotal and influential experiences of his career.

University of Otago Chancellor, Dr Royden Somerville QC, says that Mr and Mrs Hart's extraordinarily generous gift is a major contribution to the provision of dental health care.

"Their significant philanthropic support of the University will sustain the excellence in research, teaching, and community outreach that the University of Otago is renowned for. Since the University of Otago was established in 1869, as New Zealand's first university, philanthropy has been essential to maintaining its world-class reputation."

Te Kāika health hub opens

The Faculty of Dentistry are proud to be part of a new iwi-driven health hub for Māori, Pasifika and low-income families in the Dunedin area, focusing on affordable, high quality health and social services, which officially opened its doors in February 2018.

Around 200 people attended the opening of Te Kāika, which aims to deliver a number of health and wellbeing services for Māori, Pasifika and low income families. It is situated in the former College Street School in Caversham, Dunedin.

The services at the former School buildings include a primary health care service (Te Mataora), which provides affordable GP and dental services, the latter provided by staff and students of the Faculty of Dentistry.

The University of Otago will also use the centre to train students from across Health Sciences, including dentistry, medicine, pharmacy and physiotherapy.

The initiative, which has been three years in the making, aims to inspire other areas to take up a hub-based model of health services.

Te Runanga o Otakou chair Donna Matahaere-Atariki, one of the founders of Te Kāika, emphasised Te Kāika would embody both health and wellbeing services.

“This is about being really pragmatic and saying people live complex lives, and we need to be able to respond to that complexity without freaking out about it,” Ms Matahaere-Atariki said.

“Given the group we were focused on were those historically underserved by those institutions, it wasn't about doing things for people – it was about creating an environment to help people make their own decisions.”

Among those at the opening was former Whanau Ora minister Dame Tariana Turia, who praised Te Kāika for being an inspirational model of collaboration.



Komene Cassidy from the Centre for Māori Development, University of Otago, addresses the crowd at the Te Kāika opening.

“In many ways what you're doing is reflecting on the foundational essence of your community, and identifying the diverse strains that make us this village, and that is something to be proud of,” Dame Turia told the crowd.

“Te Kāika is exactly what we intended for Whanau Ora.”

The University's Pro-Vice Chancellor (Health Sciences) Professor Peter Crampton told the crowd there were a number of key benefits for all parties.

“The University of Otago is very proud, and humbled, to be a partner in this initiative led by Ngāi Tahu,” Professor Crampton said.

“And let me remind everyone again why Te Kāika is important – because we aim to provide a range of high quality health and social services to support whanau, Pacific families and low income families in Dunedin in order for them to be in control of, and in charge of, their lives.”

Professor Crampton also paid tribute to Otākou Rūnanga chair Donna Matahaere-Atariki and Albie Laurence, who he described as the intellectual architects of Te Kāika.

Te Kāika is a partnership between Arai Te Uru Whare Hauora, Te Rūnanga o Ōtākou, and the University of Otago. It is run by Otakou Health Limited (OHL), a charity founded in 2015 aimed at bringing affordable health and wellbeing services to Dunedin.

Te Pūtahitanga o Te Waipounamu (the South Island Whānau Ora Commissioning Agency) has provided funding for start-up and infrastructural costs, while Te Rūnanga o Ngāi Tahu has also strongly supported the project.

Initially focused in the Dunedin south area, it is expected to attract families from across the city.

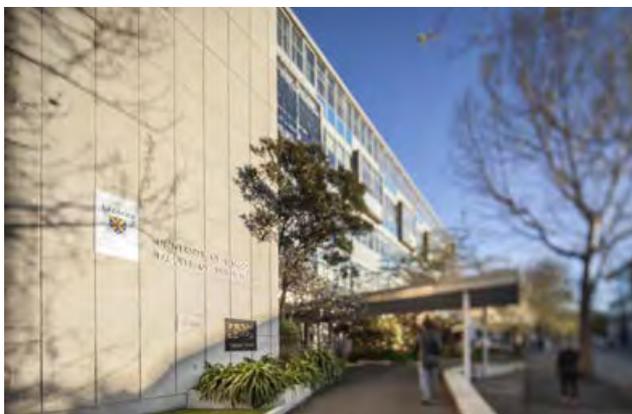
Left: Te Runanga o Ōtākou chair Donna Matahaere-Atariki and Ngai Tahu kaiwhakahaere Lisa Tumaha'i unveil the plaque outside Te Kāika.

World ranking success

Dentistry at Otago maintains top 30 world ranking in 2017-18

The University of Otago has maintained its ranking among the top 30 institutions in the world in the subject area of Dentistry, according to the QS World University Rankings by Subject for 2017 and 2018. This ranking places Dentistry at Otago second overall of all dental schools in the Oceania region, and in the top ten across Asia-Pacific.

Dentistry at Otago ranked equal 29th worldwide in 2017, and rose two places to equal 27th in 2018. Otago was ranked seventh overall in all dental schools in the Asia-Pacific region for 2017, and sixth in 2018.



The QS subject rankings are derived on the basis of a combination of factors including Academic Reputation (how academics from other universities rate a university in a particular subject area), Employer Reputation (how employers rate a university in a particular subject area), and citations (the extent to which the work of an academic in a subject area is quoted or referenced in the work of others).

Research performance, led by the achievements of the Sir John Walsh Research Institute, are critical to the Faculty's high ranking.

In 2017, the University of Otago ranked among the top 50 institutions in the world in five subject areas and among the top 100 in 12. Otago was judged to be among the world's top 10 universities for the study of Sport and sport-related disciplines, placing seventh internationally. This was the highest ranking achieved by any New Zealand university for any subject area in the 2017 rankings, an honour held by Dentistry at Otago in 2015. Aside from Dentistry, the University had three further subjects ranked inside the top 50, namely Anatomy and Physiology (24th in QS's inaugural Anatomy and Physiology measure), Archaeology (40th) and Development Studies (44th).

In the 2018 QS World University Rankings by subject, as well as maintaining five subjects in the top 50 worldwide (with three of those, including Dentistry, improving their position within the top 50), the numbers of Otago subjects ranked between 51st and 100th increased from eight to 10. Aside from Dentistry, the University's Physical Education, Archaeology, Anatomy and Physiology and Development Studies offerings also achieved top-50 rankings.

In the broader "faculty" categories assessed for the rankings, Otago's life sciences and medicine areas (including Dentistry) were ranked 64th in the world overall for 2018, compared to 66th in 2017. Otago also secured top 100 faculty rankings for social sciences and management and for arts and humanities.

As an institution, the University of Otago climbed 18 places in the 2018 QS World University rankings from 2017 to number 151, securing its place in the top echelons of universities worldwide. Within this ranking, Otago comes in at 28th in the International Faculty indicator, with aims to assess how successful a university has been in attracting academics from other nations.

The 2018 QS rankings saw Massachusetts Institute of Technology (MIT) retain the top spot for the sixth consecutive year, followed by Stanford and Harvard. However, QS Research Director Ben Sowter says the continued dominance of the top US universities should not obscure a changing landscape elsewhere, with other US and UK institutions making way for the best of Australia, New Zealand, Russia, China and India – among others.

"New Zealand now boasts five universities among the Top 300, one more than last year and three are among the world's top 200 in our research indicator."

Mr Sowter says the international clout of the New Zealand higher education system is impressive, especially considering that it competes with far more populous and richer countries.

Staff awards and achievements

Associate Professor Jonathan Broadbent wins 2017 HRC Liley Medal

Associate Professor Jonathan Broadbent was awarded the Health Research Council of New Zealand's (HRC) Liley Medal for 2017 for a study showing a clear long-term association between a child's upbringing and the state of their teeth as a middle-aged adult.

Dr Broadbent, head of preventive and restorative dentistry at Otago, led the study to help explain how socioeconomic inequalities in dental health arise, using 40 years of data following participants from the world-renowned Dunedin Multidisciplinary Health and Development Study.

The main paper from the study, which was the most-read article in the *Journal of Dental Research* in 2016, showed that parents' socioeconomic status and beliefs about how to keep teeth healthy strongly influenced their children's beliefs and health behaviours growing up.

These factors were also associated with substantial differences in untreated tooth decay and tooth loss by the time their children reached their 30s.

HRC Chief Executive Professor Kath McPherson says the paper reveals just how critical childhood is for determining our future dental health, and that ongoing exposure to socioeconomic disadvantage increases our risk of worsening oral health as we age.

"Jonathan and his colleagues have been able to explore and model the pathways to poor oral health from birth to adulthood thanks to the invaluable and unique data accumulated through the Dunedin Study, which the HRC has supported for more than 40 years."

Dr Broadbent says the association between socioeconomic status and dental health is probably stronger in dentistry than any other area of health.

The research shows a striking inequality in dental treatment.

"Up to age 18, the study members that needed care mostly got it, but once access to state-funded dental care ended, the socioeconomic gap widened at an increasing rate as the study members aged," he says.

"In this paper, we traced the explanation back to their childhood. Those whose parents held inaccurate beliefs about what is good for the teeth grew up to also be less likely to believe in the importance of brushing, avoiding too much sugar, and visiting the dentist. They ended up with more teeth extracted or with untreated decay."



Dr Broadbent says he is fortunate to work with an excellent team of researchers using high-quality data.

"I'm extremely grateful to my colleagues and to the study participants. I hope that by being acknowledged with such a prestigious award the findings will get the attention of health policymakers. I'd like this paper to get people thinking about the way we provide dental health care, particularly to adults, for whom the social divide in dental care is greatest."

Dr Broadbent is an investigator on the HRC-funded Dunedin Study programme (\$5M) led by Professor Richie Poulton, within which he leads a project (\$1.2M) using the Dunedin Study data to investigate dental health changes from childhood to age 45 years, including the interrelationship between oral health and other aspects of health such as heart health and quality of life.

In early 2017, the Dunedin Study was awarded the Prime Minister's Science Prize and the University of Otago's Research Group Award for 2016.

Associate Professor Broadbent was among three University of Otago researchers whose outstanding achievements were recognised through the bestowing of prestigious national awards at the 2017 New Zealand Research Honours Dinner.

Professor Sally Brooker (Department of Chemistry) the Society's Hector Medal, while Department of Physics PhD student Mr Ryan Thomas won the Hatherton award.

Hosted by Royal Society Te Apārangi, the event was held on 10 October, 150 years to the day of the Royal Society's official enactment by Parliament on 10 October 1867, and was attended by their Patron, the Governor-General Dame Patsy Reddy.

Child poverty casts long shadow on oral health care

Child poverty and its detrimental impact on dental health care casts a long shadow and affects oral health into adulthood, University of Otago Associate Professor in the Faculty of Dentistry, Jonathan Broadbent says.

He welcomes the Child Poverty Action Group's report *Too soon for the tooth fairy*, released March 2018, which shines the spotlight on the implications of child poverty for oral health.

The report backs up Associate Professor Broadbent's concerns over inequality in dental health care in an opinion article published in the University of Otago Magazine 46.

His comments are based on analysis of dental data from the University of Otago's internationally recognised Dunedin Multidisciplinary Health and Development Study, tracking the lives of more than 1000 babies born in Dunedin between April 1972 and March 1973.

Now that the study members are adults, it is possible to investigate how their childhood influenced their adult dental health, and the Dunedin study is revealing.

Up to 18 years of age, more dental decay occurred among children from socio-economically disadvantaged families, but those who needed dental care mostly got it due to New Zealand's universal dental health care for children and adolescents, Associate Professor Broadbent explains.

However, this changed once access to state-funded dental care ended at age 18. By the time they were 26, the average number of teeth with untreated decay among young people from socio-economically disadvantaged families was five times greater than it had been at age 18.

"Publicly-funded dental care minimises inequality up to age 18, but then the bottom drops out," Associate Professor Broadbent says.

By age 38, the average number of teeth lost was six times greater among those who had been born into disadvantaged families than for those born into well-off families.

Socio-economic differences in tooth decay rates don't explain socio-economic inequality in dental health alone, because well-off people who eat too much sugar and have poor oral hygiene have a high rate of tooth decay too, Associate Professor Broadbent says.

"But, if you have a high rate of decay as a child and are born into a family with low-income parents, this will affect your risk of having poor dental health right through your life, not just during childhood."

In a recent research paper based on the Dunedin Study, Otago researchers investigated the pathway from childhood to having dental problems as an adult. Socio-economically disadvantaged parents were less likely to understand the dental problems caused by sugary foods or how to effectively care for teeth. Their beliefs rubbed off on their children who were more likely to hold similar unfavourable beliefs through their teens and into their 20s. They were less likely to regularly brush their teeth or go for regular dental checks.

Associate Professor Broadbent says dentists are often given a hard time by the media, portrayed by some commentators for being "too expensive", but most dental interventions are surgical and involve costly imported dental products, expensive equipment, compliance-related costs, salary for support staff – and a lot of time.

"Innovate public health interventions targeted to reduce inequalities – like a sugary drink tax – and expanded publicly-funded dental care (including preventive care for adults) deserve to be given a chance," Associate Professor Broadbent says.

www.otago.ac.nz/otagomagazine/issue46/opinion/

SJWRI Associate Investigator Dr Carla Meledandri wins 2017 Prime Minister's MacDiarmid Emerging Scientist Prize

Dr Meledandri, from the University of Otago's Department of Chemistry, was presented with her \$200,000 prize by Prime Minister Jacinta Ardern in Wellington on 13 February 2018.



NZ Prime Minister Jacinta Ardern (right) presents the 2017 Prime Minister's MacDiarmid Emerging Scientist Prize to Dr Carla Meledandri, 13 February 2018.

A long-time collaborator and Associate Investigator of the Sir John Walsh Research Institute, Dr Meledandri is exploring ways to solve problems using ultra-small materials that look, act, and react differently when they are reduced to the nano-scale.

Early applications of her award-winning science include silver nanoparticles to treat and prevent dental disease, and finding ways to store and use clean energy technologies that have the potential to replace fossil fuels.

Silver nanoparticles developed in her lab are being incorporated into a range of breakthrough products designed to fight tooth decay and infection, through a start-up company she co-founded with Dr Don Schwass from the SJWRI and Faculty of Dentistry, Silventum Limited, and a technology licensing deal with a multinational dental company.

"In all cases with dental decay, the source of the problems is bacteria," she says.

"Our technology treats the bacterial source of the disease, without staining teeth. It's particularly exciting because of the growing problems with resistance to antibiotics, which are the usual treatment for bacterial infections."

"Our nanoparticles have a completely different mechanism that doesn't allow them to become resistant."

She says tooth decay is one of the most prevalent chronic diseases in the world and the products being created through her science offer a new solution. In addition, they have the potential to make dental care more affordable, through the availability of reliable treatments that don't require repeated trips to the dentist.

Also at the cutting edge is the current focus of her fundamental science research, in which she is developing nanomaterials for use in industrial applications such as gas capture and storage, which can potentially assist to mitigate global warming.

Dr Meledandri's entrepreneurial eye and her commitment to partnering fundamental science with applications that solve problems were highlighted by the prize judges as standout strengths.



Dr Carla Meledandri and Dr Don Schwass with Dr Alexandra Tickle of Otago Innovation Limited.

A meeting with Dr Don Schwass at a speed collaboration session for academics led to a long-time partnership that Dr Meledandri says is pivotal to the success of the dental technologies they have developed.

"Don had run his own practice for 20 years so he was all too familiar with dental diseases and the fact that most current treatments deal with the symptoms not the cause. It was having his practical knowledge feed into the research that has been critical to its success.

"Knowledge of the underlying fundamental science enables us to create things on the applied side and the applied science reveals problems that the fundamental science can solve.

Dr Meledandri, who is also a Principal Investigator for the MacDiarmid Institute for Advanced Materials and Nanotechnology, was joint winner of the Norman F.B. Barry Foundation Emerging Innovator award in 2016.

She credits the spirit of collaboration amongst New Zealanders as central to her success.

"It doesn't exist other places in the same way - the connections, the opportunities to engage with other scientists and being able to establish a start-up company in a supported environment.

"I feel very privileged to be able to work in New Zealand and to have my research group's work recognised in this way."

The 2017 Prime Minister's Science Prizes, administered by the Royal Society of New Zealand, were presented to winners on 13 February 2018 at the Banquet Hall, Parliament Buildings, Wellington.



Dr Carla Meledandri and Dr Don Schwass gave a joint keynote presentation on their research into dental applications of silver nanoparticles at SJWRI Research Day, September 2014.

More honours and awards for our staff in 2017-18

Dr Dawn Coates was promoted to Research Associate Professor by the University of Otago in December 2017. Following a post-doctoral research position at the University of Cambridge and leading the Bioactive Discovery research group at AgResearch Invermay for a number of years, Dr Coates joined the University of Otago's Faculty of Dentistry as a Senior Research Fellow in 2006. A highly productive researcher and very well regarded supervisor of postgraduate students, Dr Coates' research interests are in stem cell biology and angiogenesis (blood vessel formation) in oral health and disease, with a particular interest in finding treatments for medication-related osteonecrosis of the jaw (MRONJ). Dr Coates was the winner of the SJWRI's premier commendation, the Sir John Walsh Award for Research Excellence, in 2016.

Dr Li Mei was awarded the ANZ IADR Oral Biology Award at the International Association for Dental Research Australia/NZ Divisional meeting in Adelaide, September 2017. At the same meeting, **Dr Kai Chun Li was awarded the ANZ IADR Joan Chong Award in Dental Materials.**

Professor Murray Thomson was awarded the International Association for Dental Research's Robin Heath Award for the most downloaded paper in the journal *Gerodontology* during the previous five years. This award was presented at the 96th General Session of the IADR in London, July 2018.

Dr Carolina Loch was awarded the ANZ IADR Oral Biology Award at the International Association for Dental Research Australia/NZ Divisional meeting in Perth, September 2018.

Dr Gemma Cotton was awarded with the Kiwinet Emerging Innovator award in 2018 to develop her innovations around novel antimicrobial regenerative membranes for dental applications.

SJWRI Research Day 2017



The 2017 SJWRI Research Day, highlighting the research achievements of the University of Otago's Sir John Walsh Research Institute and Faculty of Dentistry, was held on Tuesday 5 September at the Dunedin Public Art Gallery.

In its eleventh year, the Institute's annual celebration of research excellence returned to its traditional single-day duration while retaining the specialised concurrent sessions focusing on each of our SJWRI research programmes, meaning more of our staff and students could present their work to peers, fellow researchers from across the University, industry professionals and dental practitioners.

The meeting opened with keynote presentations from invited speakers Professor Peter Hunter (Auckland Bioengineering Institute and Medical Technologies CoRE, University of Auckland, *pictured left*) and Professor Alan Brook (University of Adelaide and Queen Mary University of London, *facing page*).

Other invited speakers included Professor Stephen Robertson of the Department of Womens' and Childrens' Health and A/Prof Roslyn Kemp of the Department of Microbiology and Immunology.



Keynote speaker Prof Peter Hunter, University of Auckland.

Concurrent sessions in the areas of oral molecular and immunopathology, clinical and translational research, biomaterials, molecular microbiology and craniofacial research highlighted the research of our staff and students.

The meeting closed with a presentation from sponsor representative Stephen Langdon of 3M Oral Care, and a reflective keynote address from Professor Mike Morgan, Head of the Melbourne Dental School, and an Otago Dentistry graduate

Research Day 2017 concluded with presentation of the SJWRI Awards for 2017, and farewell drinks in the ODT Gallery.



DClinDent candidates Frances Ruddiman (left) and Philippa Greer.



Keynote speaker Prof Alan Brook, University of Adelaide and Queen Mary University of London.

2017 Research Day presentation awards

Awards were presented to the best student oral presenter in each of the five session blocks, as well as the best student and staff poster competition entries. Congratulations to the following presentation award winners:

Oral presentation awards

Biomaterials/Molecular Microbiology (combined): Lisa Falland, PhD candidate

Anatomical skin/skull/brain model to measure impact force transfer and displacement upon blunt force impact (L Falland-Cheung, JN Waddell, KC Li, DC Tong, PA Brunton)

Clinical and Translational Research: Assil Russell, DClintDent candidate (Endodontics)

The Butterfly Effect: An investigation of sealer penetration and adaptation in root canals (AA Russell, NP Chandler, LT Friedlander)

Craniofacial Research: Fiona Firth, DClintDent candidate (Orthodontics)

A human periodontal ligament cell mechanical strain culture model for the study of endoplasmic reticulum stress (F Firth, T Milne, B Seo, M Farella)

Dental Epidemiology & Public Health/Paediatric Dentistry (combined): Nina Scott, DClintDent candidate (Endodontics)

Dental trauma in New Zealand adults: a secondary analysis of national survey and ACC data (N Scott, WM Thomson, P Cathro)

Oral Molecular and Immunopathology: Nawal Abdul Rahman, DClintDent candidate (Oral Pathology)

Expression of the Lysyl Oxidase family in odontogenic lesions (NA Rahman, B Seo, H Hussaini, AM Rich)

Poster presentation awards

Student: Ashley The, BOH student, NZDA R.C Tonkin Summer Scholarship recipient

Impacts of space disruptions on a Dental School learning environment (A The, L Adam (presenter), A Meldrum, P Brunton)

Staff: Dr Joanne Jung Eun Choi, Lecturer

Bond strength between modern denture base acrylics and relene materials (J Choi, TE Ng, CK Leong, HS Kim, P Li, W Jansen van Vuuren, N Waddell)



Winners of SJWRI Awards and Research Day Presentation Awards for 2017. Left to right: (back row) Dr KC Li (Staff Research Publication Award), Professor Richard Cannon (SJWRI Director), Prof Warwick Duncan (Sir John Walsh Award), Lisa Falland (Oral Presentation Award/Postgraduate Research Publication Award), Fiona Firth (Oral Presentation Award); (front row) Nawal Abdul Rahman (Oral Presentation Award), Dr Joanne Choi (Undergraduate Research Supervisor Award/Staff Poster Award), Dr Carolina Loch (Strategic Research Prize), Assil Russell (Oral Presentation Award)

SJWRI Research Day 2018

SJWRI Research Day 2018, highlighting the research achievements of the University of Otago's Sir John Walsh Research Institute and Faculty of Dentistry, was held on Thursday 30 August at the Dunedin Public Art Gallery.

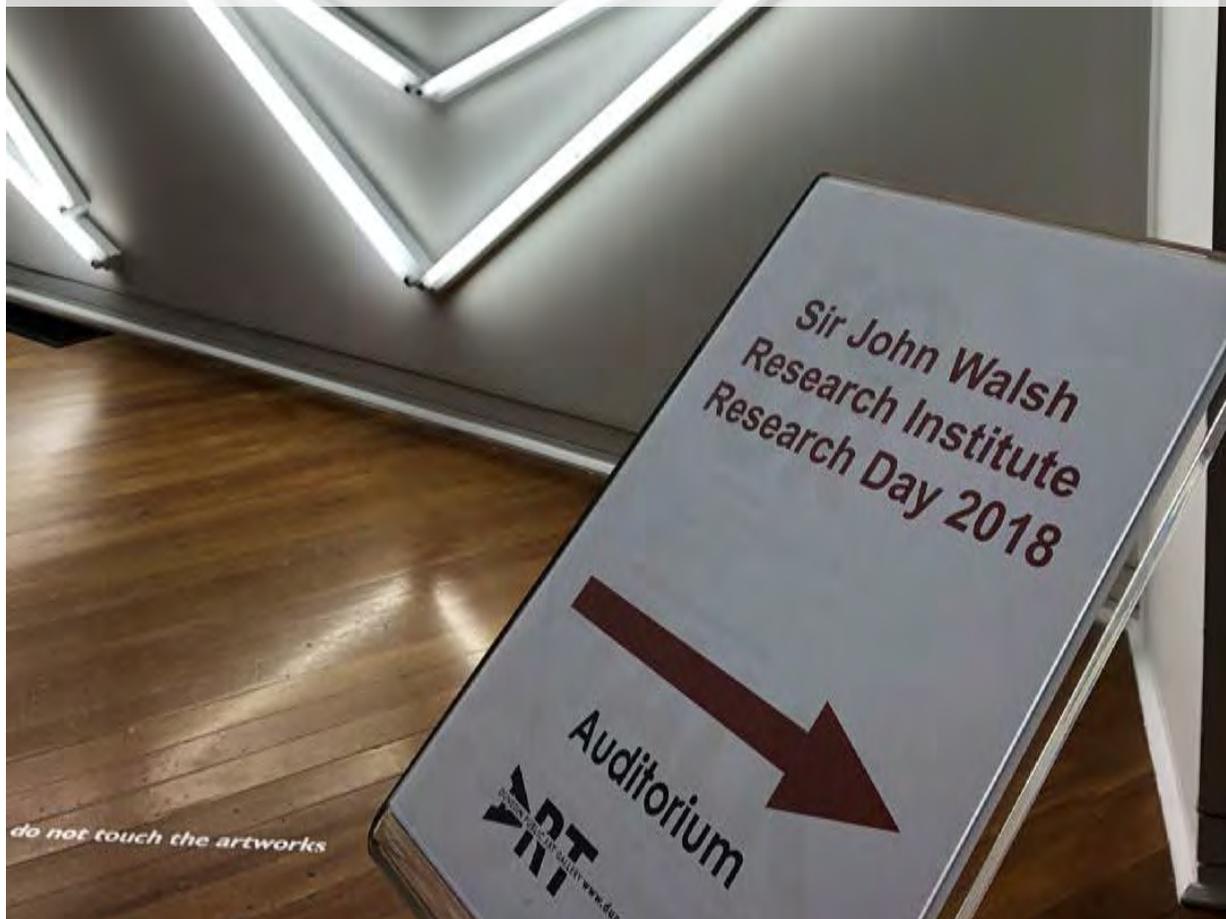
In its twelfth year, the Institute's annual celebration of research excellence was structured around the emergent themes of Understanding the Oral Health of New Zealanders, New Technologies and Therapeutics, and Evaluating our Teaching, Learning and Practice.

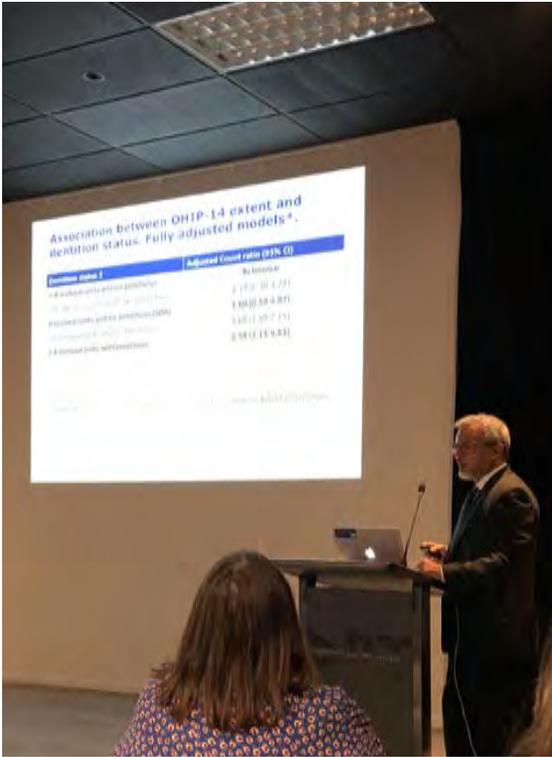
As in previous years, the opening session of Research Day spotlighted one of our areas of research strength as our featured research programme; this year, within the opening theme of Understanding the Oral Health of New Zealanders, our featured programme was Dental Epidemiology and Public Health, led by Professor Murray Thomson.

Our opening keynote was given by invited speaker Professor Marco Peres, Director of ARCPOH (the Australian Research Centre for Population Oral Health) at the Adelaide Dental School, who provided an overview of population-based oral health-related studies conducted in Australia and their relevance for surveillance and hypothesis-driven research.

Our New Technologies and Therapeutics theme was headlined by a keynote presentation from invited speaker Professor Paul Cooper of the University of Birmingham, who is currently a Sir Thomas Sidey Visiting Professor at the Faculty of Dentistry. Professor Cooper's presentation explored his research interests in dental tissue regeneration, identifying modifying factors involved in the ability of the dentine-pulp complex to heal itself and developing novel treatment approaches to facilitate these innate regenerative abilities.

The programme for the day also featured a presentation from Dr Young-Chul Kwon, Asia-Pacific Scientific Affairs & Education Manager for 3M Oral Care, providing an update on dental composites with a focus on clinical relevance. The day concluded with presentation of the SJWRI Awards for 2018, and farewell drinks in the ODT Gallery.





Above: Keynote speaker Prof Marco Peres, University of Adelaide.
 Right: Keynote speaker Prof Paul Cooper, University of Birmingham.
 Below: Poppy Horne (DCLinDent candidate), winner of the best student oral presentation at SJWRI Research Day 2018.



2018 Research Day presentation awards

Presentation awards were made to the best student oral presentations across the day, as well as the best student and staff poster competition entries. Congratulations to:

Student oral presentation awards

First prize: Poppy Horne, DClinDent candidate (Periodontics)

Psychosocial aspects of periodontal disease diagnosis and treatment (PE Horne, LA Foster Page, JW Leichter, WM Thomson, ET Knight)

Second prize: Chuen Lin Hong, PGDipComDent candidate

Personality, dental neglect, and oral health: a longitudinal study (CL Hong, WM Thomson, JM Broadbent)

Third prize: Divya Ramanan, DClinDent candidate (Orthodontics)

Jaw muscle overload as a possible cause of orofacial pain (D Ramanan, S Palla, A Polonowita, M Farella)

Poster presentation awards

Student: Hafizi Mohd Ali, DClinDent candidate

Quality evaluation of dental records and patient satisfaction following periodontal surgery (HM Ali, A Tawse-Smith, J Broadbent, W Duncan)

Staff (two awards):

Christina Gee, Assistant Research Fellow

Antimicrobial and cytotoxicity effects of silver nanoparticles on primary human gingival fibroblasts in vitro (C Gee, G Cotton, W Duncan, A Jude, D Abdelmoneim, D Coates)

Dr Jithendra Ratnayake, Assistant Research Fellow

Structural and biological characterization of a xenograft material developed from bovine cancellous bone (J Ratnayake, M Gould, M Mucalo, G Dias)



SJWRI Awards for 2017 and 2018

Congratulations to the recipients of Sir John Walsh Research Institute Awards for 2017 and 2018, which are announced and awarded at the conclusion of SJWRI Research Day each year. These Awards celebrate the research achievements of academic staff and postgraduate students, as well as commending the contribution of general staff to the research successes of the SJWRI and Faculty of Dentistry.

Sir John Walsh Award for Research Excellence

The Sir John Walsh Award, our premier research award, acknowledges excellence in research over an extended period of time by a member of staff of the Faculty of Dentistry. The recipient of our premier research award receives \$5,000 towards professional development.

2017 Sir John Walsh Award winner: Professor Warwick Duncan

Professor Warwick Duncan is the director of the Clinical and Translational Research programme within the SJWRI, as well as leading Implantology research within the Biomechanics and Oral Implantology research programme. Within the Faculty of Dentistry he is Head of Discipline of Periodontology, and in 2015 became the first Otago-qualified periodontist to be promoted to Professor at the University of Otago.



Professor Duncan's primary research interests are in periodontics (the treatment of gum diseases) and implantology (the replacement of missing teeth with dental implants). This work has extended from preliminary trials in animal disease models, to validation

in human clinical trials, and have included the development of new bone replacement grafting materials, new metals and surfaces for osseointegration of oral implants, stem-cell therapy for bone regeneration, novel approaches to the treatment of periodontal and peri-implant diseases, and new technologies for diagnostic imaging of gum and bone around teeth and implants.

Professor Duncan has demonstrated sustained research productivity extending over many years, having published over 40 journal articles over the past five years. He has supervised 40 PhD, DClinDent and Masters research theses, 24 as primary supervisor. He has been principal or named co-researcher on 75 successful grant applications since 1995 with a total value to date of \$4.78 Million, including two recent MBIE grants for >NZ1.0M each. He is a co-applicant on one provisional patent application. He has extensive international research collaborations, and is regularly invited to speak at international conferences.

2018 Sir John Walsh Award winner: Dr Erwin Lamping

Dr Erwin Lamping is a Senior Research Fellow within the Molecular Microbiology research programme of the SJWRI, whose research focuses on the structure and function of eukaryotic membrane proteins, especially integral membrane proteins associated with multidrug resistance of fungal pathogens and human cancer cells. His internationally recognised research sheds light on the evolution of resistance in fungal species and sets to aid researchers in designing new treatment strategies to overcome drug resistance.

Dr Lamping produces high quality research that is reflected in his sustained high impact factor research outputs (in journals such as Antimicrobial Agents and Chemotherapy, Molecular Microbiology and Genetics), invited collaborations and presentations, his status as an expert reviewer in numerous journals, and requested science expertise in media outlets such as The Scientist. In particular, his 2017 publication in Genetics received international attention, and was highlighted by the Genetics Society for America, for discovering valuable new clues in the fight against multi-drug

resistance. His work may aid researchers in designing new ways to overcome drug resistance and may help understand why cancer cells become resistant to multiple drugs, why people react differently to drugs and why some drugs do not work for some people.

As a co- or principal investigator, Dr Lamping has attracted nearly a million dollars in funding, including as co-PI on a major Marsden Fund grant, and as an associative investigator has received \$1,812,600. He has extensive international collaborations facilitated by Dr Lamping's co-inventorship on a patented yeast membrane protein expression system that is used worldwide by over 50 research teams.



Valuable new clues in fight against multi-drug resistance

Research into yeast, the single-celled organism behind a range of human infections, has led to SJWRI researchers identifying a previously unknown piece of genetic sleight-of-hand which may enable multi-drug resistance, a major emerging global health problem.

The research, led by Dr Erwin Lamping and supported by funding from the Royal Society Te Apārangi Marsden Fund, investigated how yeast becomes drug resistant. Through coming to an unexpected understanding of the resistance process, researchers may now be able to design ways to overcome drug resistance in humans.

To explain what they found, Dr Lamping starts with the basic process of gene mutation that organisms use to adapt.

“When a gene mutates and has another function, the original gene function is lost. However, another way organisms adapt is by gene duplication, where they make a second copy of the gene. This has the advantage that if one copy mutates and changes its function, the organism still has the original gene with its original function. This allows organisms to adapt by using almost identical genes to develop a range of different functions or abilities.”

While studying how the yeast behind human infections such as oral and vaginal thrush becomes drug resistant, Dr Lamping and his team found the organism makes a protein which pumps the drug out of the yeast cell.

“We also found, by chance, that there was a very similar gene next door - an example of gene duplication. What we discovered, which has not been found before, was that while large parts of the adjacent genes were identical, six short regions were different and had remained different for over 130 million years. The reason why they had remained different is because they were the regions that allowed the two pumps to pump different drugs.”

“We carefully studied genes from seven yeast strains originating from different parts of the world and found 30 copies of the pump gene, all with the same pattern: they had large regions that were exactly the same and small regions that differed. This shows that this mechanism of evolution is widespread - in the entire yeast population studied,” he says.

“This repetition of almost identical genes, but with different functions, may have gone unnoticed in other organisms including humans.”

This may help understand why cancer cells become resistant to multiple drugs, why people react differently to drugs and why some drugs do not work for some people.

The findings have been published in the journal *Genetics* and was highlighted by the Genetics Society of America in their popular science blog ‘Genes to Genomes’.

genestogenomes.org/the-push-and-pull-evolution-of-tandem-duplicated-drug-resistance-genes/

Research Supervisor Award

Introduced in 2016, this award is to celebrate outstanding research supervisors of postgraduate and undergraduate students within the Faculty of Dentistry. Nominations are made via a survey process, whereby students are asked to anonymously nominate outstanding supervisors, with reasons for their nominations. Attributes such as being supportive, available, interested and enthusiastic, knowledgeable and an expert in their field, a good communicator, and taking prompt, decisive action to resolve issues were listed as being important for excellent supervision.

In both 2017 and 2018, as a result of a very strong field of nominees, the award was split into undergraduate and postgraduate research supervisor awards. The winners of each award received \$1,000 towards professional development.

2017 Postgraduate Research Supervisor Award: Professor Murray Thomson

Professor Murray Thomson is the Head of Department of Oral Sciences and leads the Dental Epidemiology and Public Health Research Programme within the SJWRI. His research interests are in the areas of life-course epidemiology and longitudinal research, periodontal epidemiology and risk factors, gerodontology research, and dental public health and health services research. He is a highly productive researcher, having published 283 papers in the peer-reviewed international scientific literature to date.

Throughout his career, he has supervised to completion 64 postgraduate students, including 10 PhDs, 18 DClindents and 36 Masters graduates, more than half of which have been Masters of Community Dentistry graduates. He has another thirteen current supervisions, including two PhDs, eight DClindents, one MComDent and one Masters of Public Health. Nearly half of Professor Thomson's published output (137 peer-reviewed papers) has been co-authored with his students.

Here are a selection of comments from student nominations:

"extremely helpful and supportive throughout my research journey. He provides the right amount of guidance but lets me problem-solve and take initiative."

"Even though he has so many other responsibilities, he has always made time for me."

"an inspiring supervisor... not only have I benefited from his considerable knowledge; his organisation and timely feedback meant I was able to proceed smoothly with my research."



2017 Undergraduate Research Supervisor Award: Dr Joanne Choi

Dr Choi was recently appointed as a Lecturer within the Department of Oral Rehabilitation, having completed a PhD within the SJWRI under the supervision of A/Prof Neil Waddell, Prof Mauro Farella, Prof Karl Lyons and the late Prof Jules Kieser. Her research interests are in dental materials, craniofacial biology and clinical oral physiology, carrying out qualitative and quantitative analysis of the mechanical properties and failure mechanisms of restorative dental systems. She also has research interests in investigating the physiology of the oral environment using portable measurement systems; for her PhD, Joanne developed and validated a wired sensor system to monitor intraoral pH and temperature for long-term periods, the results of which can be used in identifying and evaluating causal factors involved with dental wear.

Dr Choi supervises undergraduate student research in the Dental Technology programme, primarily dental technology final year students within the biomaterials research paper DTEC301. She typically serves as primary supervisor for a group of 4 students as the primary supervisor every year, as well as acting as co-supervisor or advisor for other student groups. She is also involved in supervising BDS honours and elective projects.

Here are a selection of comments from student nominations:

"Joanne carries a truly genuine desire to see her students excel. She is not only passionate about research but most importantly in providing students with the most encouraging environment that builds students' interest in the topic. I particularly felt extremely encouraged to further my develop in research [from] Joanne's supervision."

"the most supportive, kind and helpful supervisor. Joanne has made me interested in research through her teaching. She gave me enough freedom to do my own research while still helping where appropriate."



Dr Joanne Choi (left), with A/Prof Neil Waddell and 2018 summer student Helene Chua.

2018 Postgraduate Research Supervisor Award: Dr Lara Friedlander

Dr Lara Friedlander, a Senior Lecturer in the Department of Oral Rehabilitation, is a specialist endodontist with research in the areas of pulp development and disease, practice-based research, dental education and immunopathology. She is Deputy Director of the Oral Molecular and Immunopathology research programme of the Sir John Walsh Research Institute.

Dr Friedlander has developed research themes in pulpal biology, regeneration and angiogenesis; and separate from this is also active in research related to Endodontic curriculum development and teaching. Results of her PhD research around pulp biology and angiogenesis associated with immature permanent teeth have been presented at international conferences and published in internationally peer-reviewed journals. This work has influenced clinical practice by providing further knowledge about pulp cell behaviour and healing following dental trauma.

Dr Friedlander is a co-supervisor of doctoral (DClinDent and PhD) students, and has had substantial competitive grant applications associated with these. Lara assists in advising on projects and funding applications including PhD pulp research which has evolved from her own research theme. She enjoys engaging with general dentists in practice-based research and is a member of the New Zealand Dental Research Foundation Board.



Dr Lara Friedlander (left) with student Payman Hamadani (DClinDent candidate in Endodontics).

Here are a selection of comments from postgraduate student nominations:

"Lara has organised our research team and worked tirelessly in getting us organised... I am very fortunate to have a supervisor with her knowledge and expertise. She is extremely well organised and sets the bar high with her leadership."

"Lara always has time to discuss my thesis. We have multiple dentists involved in collecting data and she is very helpful in following up the progress of the practitioners with me."

"She is very supportive of me and believes always I can do the work. She encourages me and teaches me the correct way in everything."

2018 Undergraduate Research Supervisor Award: Dr Sunyoung Ma

Dr Sunyoung Ma is a Senior Lecturer in the Department of Rehabilitation, specialising in prosthodontics. After completing her Doctor of Clinical Dentistry thesis titled 'Marginal bone loss around two implants supporting mandibular overdentures', Dr Ma continues to work with the Oral Implantology Research Group collecting the long-term prospective data.

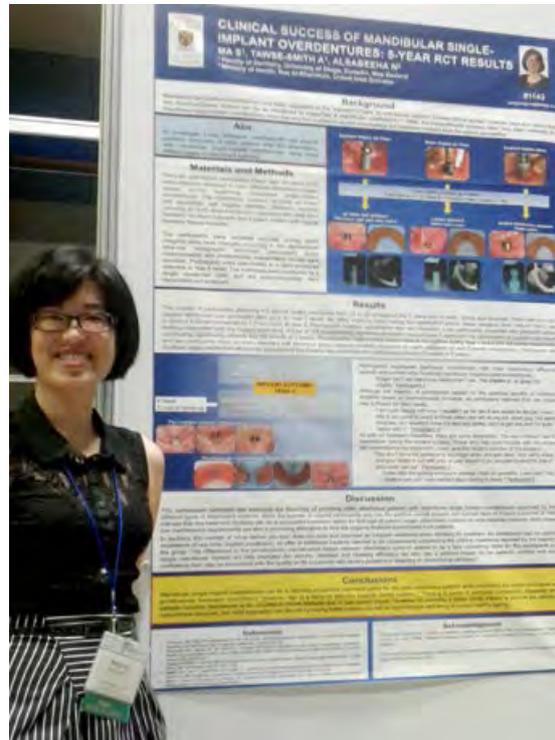
Her main focus of research lies on alveolar ridge resorption associated with implant prostheses, long-term implant success and prosthodontic maintenance issues. Dr Ma supervises undergraduate student research projects within the final-year BDS and BDS Honours programmes.

Here are a selection of comments from student nominations:

"Dr Sunyoung Ma is an absolutely fantastic supervisor and I cannot recommend her enough for this award. She is always available to her students whether it be 4.45pm on a weekday or even in a research emergency on a weekend... Her expectations of me as a research student are always clear and this can be attributed to her excellent communication skills... Dr Ma has stimulated my interest in dental research and also prosthodontics and I am both a better clinician and researcher all for her teaching. I consider myself privileged to have had the honour to work under Dr Sunyoung Ma."

"Very flexible and understanding and expresses a genuine interest in the research. Always puts the time and effort into helping and supporting us."

"Dr Ma is not only a fantastic supervisor but also a caring and supportive mentor. She constantly encourages her students to do their best and looks for opportunities to help them shine."



Dr Sunyoung Ma presenting her research at the 2016 IADR General Session in Seoul, South Korea.

Strategic Research Prize

This award is to acknowledge and promote new research within the Faculty of Dentistry, by supporting a research development initiative by a member of staff or postgraduate student that could make a contribution to the strategic direction of research within the Institute. The recipient is awarded \$5,000 in seed funding to support their proposed research project.

2017 Strategic Research Prize recipient: Dr Carolina Loch

Dr Loch was awarded the 2017 Strategic Research Prize for her project 'Reading between the lines: on the biorhythms of enamel deposition'. Tooth enamel covers mammalian tooth crowns and is the hardest and most durable substance in the body. Enamel neither remodels nor repairs, and its microstructure preserves vital information on how we develop and grow. When enamel is analysed through light microscopy, cross-striations and lines are evident. These lines, called Retzius lines, relate to growth rhythms in the secretory activity of ameloblasts and reflect biorhythms in the human body. Biorhythms are cyclic changes in an organism's growth or function that are driven by an internal biological 'clock' and synchronized through environmental cues. The periodicity of Retzius lines (RP) varies amongst human populations and between mammalian species. It has been hypothesized that the biorhythm underlying RP regulates the rate of bone growth and adult body mass via metabolism. The causes of this large variation in RP may relate to metabolic rates, growth rates or differences in body size; larger mammalian species tend to have slower RPs, slower metabolisms and extended growth periods relative to smaller bodied species. New Zealand has a demographically diverse population of European, Māori, Asian and Pasifika ancestry, with marked differences in growth rates, dental development and body mass, diet, health status and risk factors. Dr Loch's Strategic Research Prize research investigates whether the periodicity of Retzius lines in teeth is associated with height, weight, sex and self-reported ethnicity. This approach will provide a novel comparative framework for palaeontologists and anthropologists as they search for the origins of mammal growth trajectories in the fossil record. This study will be of wide interest to researchers in human biology, forensics and palaeoanthropology.



Dr Carolina Loch.



A/Prof Dawn Coates (left) with collaborators Prof Warwick Duncan and Dr Trudy Milne.

2018 Strategic Research Prize recipient: Associate Professor Dawn Coates

This project aims to establish a new strategic direction for research within the Sir John Walsh Research Institute through collaboration with A/Prof Tim Woodfield's Christchurch Regenerative Medicine and Tissue Engineering (CReaTE) Group within the Centre for Bioengineering & Nanomedicine at the University of Otago, Christchurch. This initiative develops and merges two current key competencies - our significant existing experience in the isolation and clinical application of dental pulp stem cells, and the development of 3D bio-printing for tissue engineering, which is an established strength of the CReaTE Group. They have a strong research program utilising 3D bio-printing and their considerable expertise

in the handling and crosslinking of hydrogels, suitable for in vivo application, is invaluable. By tailoring the components of the gels, crosslinking, gel density and cell seeding density we aim to generate in vivo degradable scaffolds, containing dental stem cells. These scaffolds/stem cells can then be placed into tooth models of regeneration and repair, as well as being used to form bone in conjunction with dental implants.

A/Prof Coates' Strategic Research Prize will support a two-way information exchange through travel for students and staff between Christchurch and Dunedin to consolidate this collaboration and to transfer skills in the optimisation of the complex delivery systems and share our expertise in stem cell growth and differentiation.

Research Publication Award

This award is to recognise excellence in research by acknowledging the research calibre and effort required to publish in high impact journals in science and dentistry. To be eligible, the manuscript must have been accepted for publication between 1 January and 31 December of the preceding year. The recipient receives \$1,000 towards professional development.

2017 winner: Dr Kai Chun Li

Dr KC Li is a Lecturer in Biomaterials Science in the Department of Oral Rehabilitation. His paper, "Porcelain bonding to novel Co-Cr alloys: Influence of interfacial reactions on phase stability, plasticity and adhesion" was published in the December 2016 edition of *Dental Materials*.

The objective of the study was to determine the hardness and adhesion strength at the porcelain to alloy interface of novel cobalt-chromium (Co-Cr) dental alloy restorations.

The adhesion of the alloy to porcelain was found to be inversely related to the hardness of the interfacial layer at the alloy surface. Lower interfacial hardness was found to be accompanied with higher adhesion energy due to the additional plastic energy consumed during crack propagation along the more ductile interface region of the alloy.

Dr Li was a major contributor in all aspects of the study ranging from manufacturing, testing and data analysis of the specimens to writing the publication as the corresponding and first author.

The study was submitted to *Dental Materials* on the 26th November 2015 and accepted on the 3rd September 2016. *Dental Materials* is a renowned journal in dental materials research, has a 5-year Impact Factor of 5.155 and is in the top 3 journals within its discipline.

Li, K. C., Tran, L. Y., Prior, D. J., Waddell, J. N., & Swain, M. V. (2016). Porcelain bonding to novel Co-Cr alloys: Influence of interfacial reactions on phase stability, plasticity and adhesion. *Dental Materials*, 32(12), 1504-1512. doi: 10.1016/j.dental.2016.09.008

2018 winner: Dr Susan Moffat

Dr Susan Moffat (below) is a Senior Lecturer in the Department of Oral Sciences, Susan Moffat's field of research includes dental public health, dental therapy history, and the dental therapy and oral health workforce.

Dental therapy is an academic discipline which has until recently had little research tradition of its own, having relied traditionally on work undertaken in the disciplines of paediatric dentistry and dental public health. In that respect, Susan is one of the pioneers in dental therapy research, with her work laying some of the groundwork for an ongoing research foundation for the discipline.



Susan's award-winning publication, in *Frontiers in Public Health*, explores the history and impact on oral health inequalities of New Zealand's School Dental Service, through its establishment, expansion, decline and eventual replacement by the Community Oral Health Service in 2006.

Moffat SM, Foster Page LA, Thomson WM. New Zealand's School Dental Service over the decades: Its response to social, political, and economic change, and the effect on oral health inequalities. *Frontiers in Public Health* 5:177 (2017)

Postgraduate Research Publication Award

This award is to recognise excellence in postgraduate student research by acknowledging the research calibre and effort required to publish in high impact journals in science and dentistry. The publication must have been accepted between 1 January and 31 December 2016, and have been written by a Masters or Doctoral research student. The recipient receives \$500.

2017 winner: Lisa Falland

SJWRI PhD graduate Lisa Falland undertook her PhD research within the Biomechanics and Oral Implantology research programme of the SJWRI under the supervision of Professor Paul Brunton, A/Prof Neil Waddell and Prof Darryl Tong.

Her paper, titled "Investigation of the elastic modulus, tensile and flexural strength of five skull simulant materials for impact testing of a forensic skin/skull/brain model", investigated different simulant materials (agar/glycerol and agar/glycerol/water) for use as a translucent brain simulant for ballistic testing.

This is of interest as access to human and animal brain tissue to model ballistic or head impact experiments is problematic, imaging of cavity formation and internal wounding mechanisms in ballistic studies is difficult due to the opacity of brain tissue, and existing simulants are of limited suitability as a brain simulant for ballistic studies.

Lisa's study looked at agar/glycerol and agar/glycerol water under a variety of conditions in comparison to fresh deer brain. Of the simulants tested, agar/glycerol/water was determined to be the most suitable brain simulant.

This is the first time that a suitable translucent brain simulant with brain-like properties has been developed and is a significant contribution to the study of ballistic injury and blood/tissue back spatter using high speed imaging. In addition, this simulant brain material can be used for physical modelling impact studies.

As lead investigator and primary author, Lisa prepared the specimens, carried out the experiments, analysed the data and wrote the manuscript, with the assistance of her co-authors.

This study was accepted for publication in September 2016 in the *Journal of Mechanical Behavior of Biomedical Materials*, which has an Impact Factor of 3.110 (5-year impact factor of 3.544) and is ranked as the #20/77 in the category Engineering, Biomedical Journals.

Falland-Cheung, L., Waddell, J. N., Li, K. C., Tong, D., & Brunton, P. (2017). Investigation of the elastic modulus, tensile and flexural strength of five skull simulant materials for impact testing of a forensic skin/skull/brain model. *Journal of the Mechanical Behavior of Biomedical Materials*, 68, 303-307. doi: 10.1016/j.jmbbm.2017.02.023.



2018 winner: Azza Al-Ani

The 2018 winner of our Postgraduate Research Publication Award, DCLinDent graduate Azza Al-Ani, conducted her DCLinDent research within the Craniofacial Research programme of the SJWRI, which is led by Professor Mauro Farella.

Her published study showed for the very first time an association between maternal smoking and offspring with hypodontia (congenitally missing teeth). When odds ratios were adjusted for possible confounders, if the mother smoked ten or more cigarettes each day during pregnancy, there was more than four times the risk (odds) that the child would have hypodontia.

The article has already had great impact, reported by media around the world. The *Journal of Dental Research* is considered the premier dental journal, with a 2017 Impact Factor of 5.380 (JCR). The journal is ranked second out of 90 journals in Dentistry, Oral Surgery & Medicine.

Al-Ani AH, Antoun JS, Thomson WM, Merriman TR, Farella M. Maternal smoking during pregnancy is associated with offspring hypodontia. *Journal of Dental Research* 96:1014-1019 (2017).



Dr Azza Al-Ani (second from left) with study co-authors Dr Joseph Antoun, Prof Mauro Farella and Prof Murray Thomson.

Mothers who smoke more likely to have babies with teeth abnormalities

Women who smoke more than 10 cigarettes a day during pregnancy are much more likely to give birth to babies who will fail to grow all their teeth, new SJWRI research has found.

The condition, known as hypodontia, commonly involves children failing to develop up to six permanent teeth, which are usually lateral incisors and premolars.

The Otago study, published in the *Journal of Dental Research*, investigated 83 children with the condition and compared them with 253 children without hypodontia.

Their mothers were asked to report active and passive smoking exposure, as well as alcohol and caffeine consumption during pregnancy.

Study lead author Professor Mauro Farella of the Faculty of Dentistry says that the research team controlled for other factors such as the mother's age when the child was born, its sex, whether there was a full-term delivery or not, and socio-economic status.

"We found no significant associations between drinking alcohol or caffeinated drinks and hypodontia, but there was a suggestion of a 'biological gradient' effect with tobacco - the more cigarettes a mother reported smoking during pregnancy, the greater the likelihood was of her child having hypodontia."

"Though more research is needed to confirm the association we found between maternal smoking and the condition, a plausible explanation is that smoking causes direct damage to neural crest cells in developing embryos," Professor Farella says.

Professor Farella says a large body of evidence exists regarding the many damaging effects that smoking has during pregnancy. These include other dentofacial defects, such as cleft lip and cleft palate.

"This latest research further reinforces the importance of women seeking support to quit smoking when they are pregnant."

The work was supported by grants from the Health Research Council of New Zealand and the New Zealand Dental Research Foundation, as well as a Fuller Scholarship grant from the SJWRI.

Research funding successes

SJWRI oral health research supported by the NZ Dental Association and Ministry of Health

The New Zealand Dental Association and Ministry of Health (MoH) are key supporters of our cutting-edge dental and oral health research, through the NZ Dental Research Foundation (NZDRF) and MoH Oral Health Research Fund grant rounds. Funding from these grants supports the research of our academic and research staff as well as training of our postgraduate students.

In 2017-18, a total of \$239,500 in funding was awarded from the NZ Dental Research Foundation for projects led by our staff, PhD and DClinDent students. SJWRI researchers were also principal or key named investigators on projects awarded \$164,439 in targeted Ministry of Health Oral Health Research funding. As always, we thank the NZ Dental Association and the Ministry of Health for their continued support of our research.

New Zealand Dental Research Foundation

Established in 1964, the NZ Dental Research Foundation awards grants for research projects related to dentistry. Its overall purpose is to “promote, foster and extend the study and practice of the art and science of dentistry in New Zealand”. Since its inception, the Foundation has provided financial support for decades of dental and oral health research projects within the Dental School and the SJWRI, to help extend the boundaries of dental knowledge and to promote the fostering and extension of the study and practice of the art and science of dentistry in New Zealand. The Research Foundation is funded by donations from dental practitioners, the dental supply industry and other businesses, as well as profits from the annual NZDA Conference and other fundraising activities. The SJWRI and the Faculty are hugely grateful for the role and contribution of the in supporting our research over the past five decades, in the process helping many of our Masters, PhD and specialising dental postgraduate students complete their studies.

In the 2017 NZDRF grant round, SJWRI researchers led projects awarded a total of \$106,068 in funding, including \$4,100 from the International College of Dentists and \$9,700 from the Continuing Dental Education Trust of Auckland.

Lead investigator	Other named investigators	Project title	Awarded
Dr Joseph Antoun	Ana Low, Dr Li (Peter) Mei, A/Prof Geoffrey Tompkins, Prof Mauro Farella	Effects of different adhesive removal methods on bacterial colonization on in vivo orthodontic bracket model	\$11,965
Deepak Chellappa	Dr Peter Cathro, A/Prof Geoffrey Tompkins	Comparing the antimicrobial efficacy of contemporary irrigation techniques in curved root canals	\$3,500
Harsha De Silva	Dr Haizal Hussaini, Prof Alison Rich	Role of <i>Candida albicans</i> in oral carcinogenesis	\$9,589
Philippa Greer	Dr Dawn Coates, Dr Benedict Seo, Dr Haizal Hussaini, Prof Alison Rich	The regulation of galectin-1 and implications for epithelial-mesenchymal transitioning in oral squamous cell carcinoma	\$14,584
Poppy Horne	A/Prof Lyndie L Foster Page, Prof Jonathan Leichter, Prof Murray Thomson, Dr Ellie Knight	Psychosocial aspects of periodontal disease diagnosis and treatment	\$4,100 (ICD)
Dr Erwin Lamping	Prof Richard Cannon	NanoBRET - a novel and versatile protein reporter technology for oral health research	\$5,696
Adelyn Lau	Prof Darryl Tong, Prof Murray Thomson, A/Prof Rohana De Silva, Harsha De Silva	The use of dexamethasone in the reduction of post-operative outcomes after wisdom teeth surgery. A comparison of two routes of administration	\$9,700 (CDET)
Dr Li (Peter) Mei	Prof Richard Cannon, Prof Mauro Farella	Management of biofilm formation with Air-Flow in patients with fixed orthodontic appliances	\$5,512

Lead investigator	Other named investigators	Project title	Awarded
<i>Sabarinath Prasad</i>	Prof Mauro Farella, A/Prof Michael Paulin (UO Zoology), Prof Sandro Palla (U Zurich)	Validation of a wireless device to access EMG activity in freely moving subjects	\$5,380
<i>Amira Salem</i>	A/Prof Geoffrey Tompkins, Dr Peter Cathro	Novel therapeutic targets for endodontic infections	\$14,900
<i>Oripa Waqa</i>	Dr Benedict Seo, Dr Haizal Hussaini, A/Prof Rohana De Silva, Prof Darryl Tong, Prof Alison Rich	BRAF mutations in ameloblastoma: Correlation with clinical and histopathological features and behaviour	\$7,600
<i>Elizabeth Williams</i>	Dr Dawn Coates, Dr Benedict Seo, Dr Haizal Hussaini, Prof Alison Rich	Human papillomavirus in oral verrucal-papillary lesions: detection by polymerase chain reaction	\$13,542

Named investigators are from the SJWRI/Faculty of Dentistry, University of Otago unless otherwise noted.

Italicized names are doctoral research (PhD/DClinDent) candidates.

ICD: International College of Dentists Award.

CDET: Continuing Dental Education Trust (Auckland) Award.

In the 2018 NZDRF grant round, projects led by SJWRI researchers were awarded a total of \$133,432 in funding, including \$4,100 from the International College of Dentists and \$11,654 from the Continuing Dental Education Trust of Auckland.

Lead investigator	Other named investigators	Project title	Awarded
<i>Mohammad Arshad Aziz</i>	Dr Benedict Seo, Dr Haizal Hussaini, A/Prof Marilyn Hibma (UO Pathology), Prof Alison Rich	Analysing heat shock proteins and mRNA of specific oncogenes within exosomes derived from oral cancers	\$15,000
Dr Manikandan Ekambaram	Prof Cynthia KY Yiu (UHongKong), A/Prof Neil Waddell, Dr Kai Chun Li, Sam Lowrey (UO Physics), Dorothy Boyd, Yu-Lynn Lee	Bonding universal dental adhesive resin to developmentally hypomineralized enamel	\$14,970 (\$4,100 from ICD)
<i>Rachel Farrar</i>	Prof Mauro Farella, Prof Warwick Duncan, Dr Joseph Antoun, Prof Birte Melsen (UAarhus)	Development of an ovine model for investigating effects of orthodontic tooth movement	\$15,000
Dr Lara Friedlander	<i>Shaikha Al Samahi</i> , Dr Trudy Milne, Dr Haizal Hussaini, Prof Alison Rich	Type 2 diabetes - how do human dental pulp cells respond to glucose and lipopolysaccharides?	\$14,890
<i>Danielle Hodgkinson</i>	Prof Mauro Farella, Dr Joseph Antoun, Dr Li Mei, Dr Austin Kang	Do orthodontic extractions ruin faces?	\$11,654 (CDET)
Dr Haizal Hussaini	Dr Harsha de Silva, <i>Sajith Edirisinghe</i> , Dr Trudy Milne, Prof Alison Rich	Expression of vascular endothelial growth factor and associated pathways in oral squamous cell carcinoma	\$14,496
Ludwig Jansen van Vuuren	Prof Warwick Duncan, A/Prof Neil Waddell, A/Prof Jonathan Broadbent	Development of a simulant model for clinically relevant testing of implant- and natural tooth-supported all-ceramic restorations [Phase Two]	\$10,000
Dr Hee Ji Lee	Prof Richard Cannon, A/Prof Brian Monk	Automated pipetting system for oral health and dental research	\$15,000
<i>Saeideh Nobakht</i>	A/Prof Dawn Coates, Prof Warwick Duncan, Dr Trudy Milne	Pleiotrophin family gene and protein expression in a sheep tooth socket model of bone healing	\$14,255
<i>Nurul Izyan Zainuddin</i>	Dr Haizal Hussaini, Dr Benedict Seo, Prof Alison Rich	Neuropilin-1 expression in the tumour microenvironment of oral squamous cell carcinoma	\$8,167



Prof Warwick Duncan, Prof Mauro Farella, Dr Joseph Antoun and Rachel Farrar.



Sajith Edirisinghe and Dr Haizal Hussaini.

Ministry of Health Oral Health Research Grants

In 2007, the NZ Ministry of Health established a funding programme for oral health research, managed by the NZDA and its Research Foundation, to fund research targeted towards the oral health priorities of the Ministry. Priority is given to oral health research that targets children and adolescents; people of all ages with physical, intellectual, behavioural, or cognitive disabilities, or who are medically compromised; people experiencing inequalities of outcome (e.g. Maori, Pacific and low-income populations); maternal oral health; older adults; and research focusing on promoting oral health, building links with primary care and building the oral health workforce.

In the 2017 MoH Oral Health Research round, SJWRI researchers were named investigators on awards totalling \$68,697.

Lead investigator	Other named investigators	Project title	Awarded
A/Prof Sheila Skeaff (UO Human Nutrition)	Prof Bernadette Drummond	To determine the actual fluoride intakes of New Zealand children living in fluoridated and non-fluoridated areas of the lower South Island	\$14,698
Dr Moira Smith (UOW Public Health)	Prof Murray Thomson	Public-sector oral health service provision for high needs and vulnerable New Zealanders	\$44,029
Nurulhuda Thiyahuddin	Prof Richard Cannon, Dr Erwin Lamping, Prof Alison Rich	Candida species and strains in the oral cavity of the elderly: a comparison between people in home-based care and in an aged care facility	\$9,970

In the 2018 MoH Oral Health Research round, SJWRI researchers were named investigators on awards totalling \$95,742. Of this, \$53,093 was awarded to projects led by SJWRI investigators.

Lead investigator	Other named investigators	Project title	Awarded
Dr Lara Friedlander	Payman Hamadani, Prof Nick Chandler, A/Prof Ben Daniel (HEDC)	Managing elderly patients requiring endodontic treatment - a New Zealand practice based research study	\$9,463
Dr Lee Smith	Prof Murray Thomson, Dr Moira Smith (UOW Public Health)	The barriers to, and facilitators for, maintaining oral health and hygiene amongst a cohort of 40 dentate older home-based residing people who require additional living support	\$43,630
Dr Moira Smith (UOW Public Health)	William Leung (UOW Public Health), Prof Murray Thomson, Dr Graeme Ting	Estimating unmet dental need and associated resource utilisation costs, and exploring treatment funding options, for dependent older New Zealanders	\$42,649

Lottery Health Research grants support SJWRI research projects and equipment purchases

Congratulations to Professor Paul Brunton and Dr Joanne Choi, who each led successful funding applications to the Lottery Health Research grant round awarded in March 2018.

Prof Brunton's funding is for a new research project involving a novel approach to treating root caries in the elderly using chlorhexidine-modified glass ionomer cements. The proposal, also involving Prof Karl Lyons, Dr Carolina Loch, Dr Nick Heng, Prof Richard Cannon, Jithendra Ratnayake and Hassan Mohammed Ahmed, was awarded \$46,482. Here is a summary of their research project:

We want to investigate the clinical effectiveness of a new treatment for root caries in elderly patients using a noninvasive technique (atraumatic restorative technique, or ART). We will recruit 34 patients from the Faculty of Dentistry clinics. Root surface caries lesions will be restored with conventional glass ionomer cement (GIC) and modified GIC with chlorhexidine. Microbial analysis will be undertaken on samples of whole unstimulated saliva and dental plaque from the supragingival margins and interproximal region of the carious teeth connected prior to the ART application and after one-, three- and six-months. Microbial analysis will evaluate whether modified GIC with chlorhexidine would significantly increase the antimicrobial properties in comparison to conventional GIC during the investigated time period.

Dr Choi's funding (\$120,000) will support the purchase of a Neoplus UFW200 Universal multi-function wear test system to carry out novel, in-depth research on dental wear. The equipment will also support multi-disciplinary projects in the SJWRI and across the University of Otago. Named investigators include Dr Loch, A/Prof Neil Waddell and Prof Warwick Duncan.

Like all our other body parts, our teeth are exposed to a complex, changing environment. They are constantly exposed to forces (chewing food and clenching/grinding of teeth), temperature (hot/cold drinks) and pH (acidic soft drinks), leading to tooth wear. As dental wear affects the aesthetics, function and longevity of our teeth, particularly given our ageing population, this issue is of great importance to New Zealand health. To understand complex dental wear mechanisms such as attrition, abrasion and erosion, a modern wear-testing system is needed. We are applying for an equipment grant to purchase a universal, multi-purpose wear-testing system to conduct novel, in-depth research on dental wear. This equipment will be invaluable for dental research and will be shared with other research groups conducting multidisciplinary projects in anatomy, material science, geology and engineering.

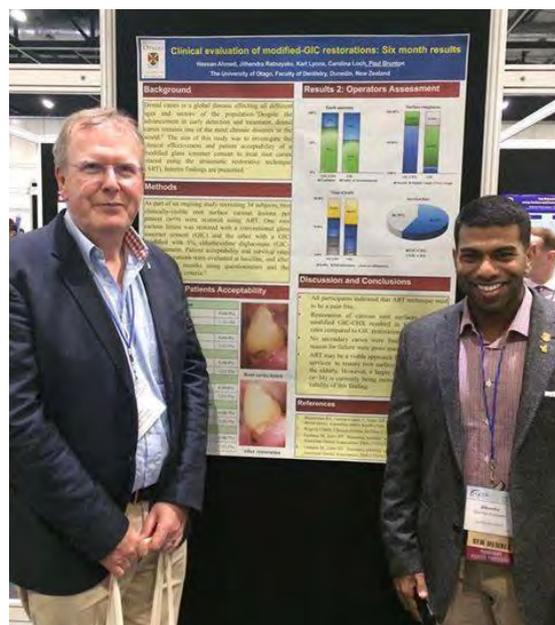
Dentistry Dean appointed PVC of Health Sciences

Dean of the Faculty of Dentistry, Professor Paul Brunton, was appointed Pro-Vice-Chancellor of the Division of Health Sciences in June 2018.

He replaced Professor Peter Crampton, who stepped after 7½ years as PVC Health Sciences and Dean of the Medical School.

Prof Brunton became Dean of Dentistry in 2015. Since arriving from the UK, he has overseen the rebuilding of the dental school facilities.

"I relish a new challenge and it is a privilege to lead the division through what I believe is going to be a period of unprecedented change with significant infrastructure projects being developed alongside a new hospital planned for Dunedin," Prof Brunton said on his appointment.



Prof Paul Brunton and Dr Jithendra Ratnayake at the IADR General Session in London, July 2018.

International Team for Implantology supports new implant research at SJWRI



Our congratulations to the SJWRI's Dr Momen Atieh, who in December 2017 was awarded AUD \$220,000 from the International Team for Implantology for his project "Titanium-zirconium narrow (3.3 mm) versus standard (4.1 mm) diameter dental implants for replacing single posterior missing teeth: a randomized controlled trial".

Numerous clinical studies have previously reported high success rates of narrow-diameter implants, but with limited data on patient outcomes and the need for additional bone augmentation. The use of narrow-diameter implants can minimise the need for bone regenerative procedures, promote early bone formation, and improve the primary stability of the implant. This will provide a cost-effective treatment approach that will likely limit unnecessary discomfort, cost, clinical time, and increase both the patients' and clinicians' acceptance.

The aim of Dr Atieh's research is to evaluate the clinical outcomes and success rates of narrow- versus standard-diameter single implants placed and loaded to replace single missing teeth at sites with limited availability of bone volume.

The ITI is a global association of professionals in implant dentistry, headquartered in Switzerland. The objectives of the ITI are the promotion and dissemination of knowledge about implant dentistry and related fields, and to support and facilitate cutting edge research in this field. Dr Atieh's award was the first time an Otago researcher had been funded by ITI.

In May 2018, the ITI approved the Fellowship nomination of Dr Momen Atieh. Fellows are regarded as the 'leaders' of the ITI and attend the Annual General Meetings, which are exclusive to Fellows. They also contribute to discussions on matters that affect the ITI and have the right to vote on decisions of the organisation.

Unprecedented success for our early-career staff in University of Otago Research Grant rounds

Academic staff from the SJWRI and Faculty of Dentistry achieved unprecedented success in the University of Otago Research Grant (UORG) rounds run in 2017 and 2018.

In the most recent round, awarded October 2018 for grants beginning in 2019, UORG applications from the SJWRI were funded at an unprecedented 85% success rate, with the majority of awards made to new and early-career academic staff.

2019 University of Otago Research Grants awarded to SJWRI/Dentistry staff, Oct 2018

Dr Kai Chun (KC) Li was awarded \$57,000 for his grant proposal *Development of 3D-printed crowns to enable non-invasive treatment of dental caries in primary teeth*.

Dr Joanne Choi was awarded \$44,900 for *Investigation of pressure distribution in edentulous patients: Development and validation of simulation systems*.

Dr Graeme Ting was awarded \$44,208 for *Oral health knowledge and attitudes of carers of home-based dependent older people*.

Dr Carolina Loch was awarded \$25,931 for *Dolphin teeth as a biomonitoring tool of heavy metal exposure*.

Dr Peter Cathro was awarded \$11,490 for *Development of a novel bone graft material from waste bovine teeth for dental surgery applications*.

Dr Manikandan (Mani) Ekambaram was awarded \$8,060 for *Family functioning and oral-health-related quality of life among children following dental treatment under general anaesthesia*.

2018 University of Otago Research Grants awarded to SJWRI/Dentistry staff, Oct 2017

Prof Murray Thomson was awarded \$15,000 for *Public-sector oral health service provision for high needs and vulnerable New Zealanders*.

Dr Kai Chun (KC) Li was awarded \$36,680 for *Developing a simulant skull model with accurate mechanical properties using 3D-printed polymers*.

Dr Joanne Choi was awarded \$23,000 for *Development of tooth-coloured shell crowns to treat dental caries in children*.

Student awards and achievements

Postgraduate research students shine in SJWRI and Otago Three Minute Thesis competitions

The 2017 edition of SJWRI 3MT, our three-minute thesis competition for postgraduate research students, was held on 28 June in the Hunter Centre.

SJWRI 3MT challenges our students to present their research in an engaging manner, able to be understood by a general audience with no background in the research area. This competition develops our postgraduate students' research communication skills, as well as giving them the chance to tell us a little more about their project.

As in previous years, SJWRI 3MT entrants were required to present for no longer than three minutes on the topic of their thesis, describing the research, and communicating the significance of the work.

Presentations were judged on the following criteria:

1. Communication style

Was the thesis topic and its significance communicated in language appropriate to an intelligent but non-specialist audience?

2. Comprehension

Did the presentation help the audience understand the research?

3. Engagement

Did the oration make the audience want to know more?

This year's competition saw a broad range of presentations from PhD, DClintDent and Masters students on topics ranging right across the spectrum of SJWRI research, from public health to molecular microbiology. All presentations were of an excellent standard and communicated their subject matter well.

This year's winner of first prize was first-year PhD student Sabarinath Prasad, of the Craniofacial Research programme, for his presentation 'The S.M.A.R.T. Study'. Sabarinath's project involves developing wireless devices to measure muscle activity in real time via surface electromyography.

The runner up was Yasmeen Ruma, who had recently commenced her PhD in the Molecular Microbiology research programme, with her presentation 'Structure-directed antifungal drug discovery'.

Congratulations to our winners, and to all who entered. Our thanks to 3MT judges Claire Gallop, Dr Diana Rothstein and Prof Richard Cannon.



2017 SJWRI 3MT winner Sabarinath Prasad with SJWRI Director Professor Richard Cannon.



2017 SJWRI 3MT runner-up Yasmeen Ruma receiving feedback from judge Claire Gallop.

Sabarinath went on to represent the SJWRI and Faculty of Dentistry in the University of Otago 3MT, along with Faculty of Dentistry lecturer Deanna Beckett who competed in the Masters section of the competition.

The Otago 3MT is a competition in which the SJWRI has a very strong history; in 2015, SJWRI PhD graduate Jenny McDowell won the Otago 3MT overall, and went on to perform strongly in the Trans-Tasman final.

On 20 July, Sabarinath Prasad and Deanna Beckett won the Doctoral and Masters heats of the Divisional round of the Otago 3MT, defeating very strong fields of postgraduate students from across the Dunedin-based Division of Health Sciences departments and schools.

The University-wide Grand Final of the Otago 3MT was held on 4 August, with eleven doctoral and masters students facing off. Deanna won the Masters category of the event, with her presentation on oral health, quality of life, and economic evaluation.



Dentistry's Deanna Beckett presenting in the SJWRI 3MT competition.

In her winning presentation, Deanna discussed the way her research aims to provide evidence to the government that oral health is important and affects a person's quality of life, and that there should be funding for treatment. She says she was thrilled to win.

"It was very exciting. There were lots of amazing students doing amazing things, and I felt very privileged to have made it as far as the finals. I also feel very happy to be able to represent both the Department of Preventive and Social Medicine, and the Faculty of Dentistry, as my supervisors were from both disciplines, and they are equally important to me."

"To start with it was incredibly daunting, particularly as I needed to be able to simplify what I considered a complex topic enough to make it understandable and interesting to a lay audience," Ms Beckett says. "It was a very worthwhile exercise however, and it really helped me to learn to be concise, and get to the point."



2017 Otago 3MT finalists. Back row (from left): Alex Wilson, Adam Denny, Andrew Mills, Adeel Akmal and Rafaela Costa Camoes Rabello. Middle row (from left): Ellie-May Jarvis, Sabarinath Prasad, Josie Cairns and Chidimma Aham-Chiabuotu. Front: Nicola Beatson (PhD winner). Absent: Masters winner Deanna Beckett. Photo: Sharron Bennett.

Nicola Beatson, Teaching Fellow and PhD candidate of the Department of Accountancy and Finance won the PhD category of the 2017 3MT for her research on the role of self-efficacy in accounting education, and whether confidence and self-belief matter when learning accounting. She had previously won the Masters category of the 3MT in 2015.

Deanna went on to represent Otago at the Masters 3MT Inter-University Challenge at Victoria University of Wellington on 24 August 2017, where her presentation won the 'People's Choice' award.

Inaugural SJWRI PhD Scholarships awarded

The SJWRI PhD Scholarship, introduced in 2018, is a prestigious award to support doctoral research in the Sir John Walsh Research Institute. In its inaugural year, the Scholarship consisted of a NZ\$20,000 stipend per annum for three years, plus domestic tuition fees for 36 months. The Scholar also received a NZ\$3,000 project seeding grant to cover initial research expenses, in the name of their primary research supervisor.

The 2018 recipient of the SJWRI PhD Scholarship was Parham Hossaini (lead supervisor Prof Brian Monk). A one-year scholarship was awarded to third year PhD student Amira Salem (lead supervisor A/Prof Geoff Tompkins) to support her through her final year of PhD candidature.

Our congratulations to both recipients, and to their supervisors.

IADR New Zealand Section Colgate student poster competitions

2017 competition

The New Zealand Section 2017 Colgate Poster Competition was held in three sessions between 11 and 18 May 2017. There was a record 14 entries: 6 in the Senior Category and 8 in the Junior Category including one Bachelor of Oral Health student.

The Senior Category winner was Soo-Wee Ong, DCLinDent candidate in Oral Surgery, for his presentation *Third molar surgery outcomes: a comparison between intravenous sedation and general anaesthetic*. Runner-up was Fiona Firth, DCLinDent candidate in Orthodontics, with *The effect of mechanical strain on periodontal ligament cells in a three-dimensional culture*.

The Junior Category winner was Danni Chen who presented a poster titled *Identifying contact points for the development of next-generation antifungals*, while the runner-up was Michelle Chew with her presentation *One abutment, one time*.

Danni and Michelle were awarded ANZ Division Travel Grants, and Soo-Wee and Fiona awarded NZ Section Travel Grants to present their research at the 57th Annual Scientific Meeting of the IADR ANZ Division in Adelaide, South Australia, in September 2017.

The NZ Section would like to thank the 2017 competition judges, Associate Professor Jonathan Broadbent, Professor Nick Chandler and Dr Nick Heng.

2018 competition

The New Zealand Section 2018 Colgate Poster Competition was held in June 2018. There were 8 entries: 2 in the Senior Category and 6 in the Junior Category.

The Senior Category winner was Maggie Hsiao-Mei Chen, DCLinDent candidate in Prosthodontics, with her presentation *Reliability of RFA in Assessing Implant Stability: A Retrospective Analysis*.

The winner in the Junior Category was fourth year BDS student Anne Jude with *Cytotoxicity of nanosilver on primary human gingival fibroblasts in vitro*. Runners-up were final-year BOH student Lauren Allen with a poster titled *Comparison of F_1F_0 -ATPase amino acid sequences between oral streptococci* and final-year BDS student Manish Kumar with *Confirmation of three predicted disulphide bonds in *Candida albicans* Cdr1*.

Maggie, Anne, Lauren and Manish were awarded travel grants from the IADR NZ Section and Colgate to present their research at the 58th Annual Scientific Meeting of the IADR ANZ Division in Perth, Western Australia, in September 2018.

Manish Kumar went on to finish as runner-up in the Junior Category of the Colgate IADR ANZ Poster competition at the 58th Annual Scientific Meeting of the IADR ANZ Division, and will be supported by the ANZ Division to attend the 97th IADR General Session in Vancouver, Canada in June 2019.

Winning posters from the 2018 IADR NZ Colgate competition were part of a display of SJWRI research posters that featured on the Faculty's exhibitor booth at the NZ Dental Association Annual Conference at SkyCity Auckland, August 2018.

The NZ Section thanks the 2018 competition judges, Associate Professor Jonathan Broadbent, Dr Nick Heng, and Dave Purton.



Professor Nick Chandler stood down as President of the New Zealand Section of the IADR at the beginning of 2018. The NZ Section expresses its gratitude to Nick for his sterling service over an extended period (2006-2017) and in particular, for his efforts in organising the annual Colgate student poster competition. An election for President of the Section took place in April 2018, with **Associate Professor Jonathan Broadbent** elected as the new President.

Outreach activities

During 2017-18, the SJWRI represented the Faculty of Dentistry and University of Otago at a number of national and international meetings. These included the 94th General Session of the International Association for Dental Research in San Francisco in March 2017, the 95th General Session of the IADR in London in June 2018, and the NZ Dental Association Annual Conference in Auckland, August 2018.

95th General Session of the IADR

Moscone West Convention Center, San Francisco, California
22-25 March, 2017

Below: Images from the exhibitor booth and poster session, IADR 2017.

Right: SJWRI Administrator Nicole Summerfield and Faculty of Dentistry Academic Administration Manager Claire Gallop, who organised and staffed our SJWRI and Faculty of Dentistry booth at IADR 2017.





University of Otago Postgraduate Open Day 2017

SJWRI Administrator Nicole Summerfield on the Faculty booth with an unidentified colleague, possibly from the Department of Marine Science, but definitely not Faculty of Dentistry Marketing & Communications Coordinator Dr Fiona McDonald.

96th General Session of the IADR

ExCeL London, 25-28 July 2018



Above: Images from the exhibitor booth and poster session, IADR 2018.

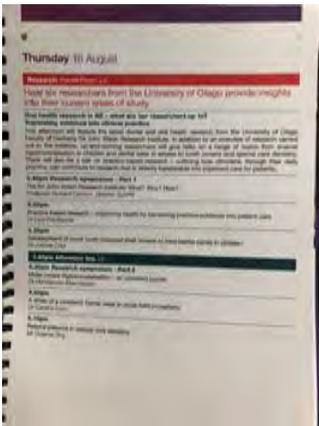
Top left: Dr Carolina Loch presented as part of a symposium on Dental Education Outreach, hosted by Prof Paul Brunton and Prof Richard Cannon from the SJWRI and Faculty of Dentistry.

Top right: SJWRI Administrator Nicole Summerfield and Faculty of Dentistry Administrator Sarah Shepherd, who staffed our booth at IADR 2018.

NZ Dental Association Annual Conference

SkyCity Convention Centre, Auckland

15-18 August 2018



Top row: The SJWRI was invited to present a symposium on the Thursday afternoon of the conference on cutting-edge dental and oral health research at the University of Otago. Top left: Speakers were (L-R) Dr Graeme Ting, Dr Lara Friedlander, Dr Joanne Choi, Dr Carolina Loch, Dr Manikandan Ekambaram and Professor Richard Cannon, who opened the symposium and gave an overview of our research (top right).

Bottom row: The SJWRI hosted an exhibitor booth on behalf of the Faculty of Dentistry and University of Otago, featuring a display of recent research posters from staff and students, with an associated CPD activity. Much of the research presented was funded by the NZ Dental Association through NZ Dental Research Foundation annual grants and NZDA Summer Studentships.

Outreach project educates children about “hidden sugars”

An outreach project led by the Faculty of Dentistry is helping to educate primary school aged children about healthy food choices and good oral hygiene.

Sugary foods and fizzy drinks have become common dietary choices for children. The consequences of this are increases in the prevalence of diabetes, obesity and dental caries in New Zealand people, particularly so for Māori. But are children and their whānau aware of how much sugar there is in snacks and fizzy drinks? Are they aware of the hidden sugar content in processed foods? Do they know the effects of sugar on teeth and on our general health?

The project, *Sugar in your diet – kino te pail*, has seen staff and postgraduate students from both Dentistry and Human Nutrition work with Dunedin’s Te Kura Kaupapa Māori o Ōtepoti staff, pupils and their whānau to investigate the hidden sugar content in their diet and how pupils can improve their oral health.

Each month the team visits with a science experiment to help the pupils discover the effects of sugar on teeth and their general health, and in parallel, a tooth brushing and oral hygiene intervention has also been implemented – with the children brushing their teeth every day at school.

The project enables children to examine their diets and report their findings to their whānau and wider community. The project is coordinated by Dr Carolina Loch from the Department of Oral Sciences, in collaboration with A/Prof Lyndie Foster Page, Prof Richard Cannon and Deanna Beckett from the Faculty of Dentistry’s Sir John Walsh Research Institute, and Dr Lisa Te Morenga of the Department of Human Nutrition. The project is supported by the Otago Participatory Science Platform, administered by the Otago Museum, and by the MBIE Curious Minds fund.

Dr Carolina Loch says the small school, located in the Dunedin suburb of Fairfield, has a predominantly Māori student base, making it an excellent school to work with on this project.

“In New Zealand in general, Māori children have less opportunity to engage with science and technology, have higher rates of obesity and diabetes, have poorer oral health and are more likely than other people to have tooth fillings or extractions due to poor oral hygiene. Our project is a good way to tackle some of these issues,” she says.



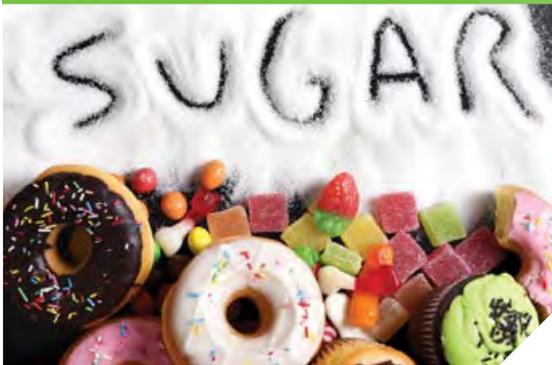
Pupils enjoyed the science experiments teaching them more about the effects of sugar on their teeth.

UNIVERSITY OF OTAGO
Te Kaupēka Pūniho
New Zealand's National Centre for Dentistry

CURIOUS MINDS

Sugar in your diet: kino te pai!

A University of Otago and Te Kura Kaupapa Māori o Ōtepoti joint project on the importance of healthy food choices and good oral hygiene



Funding from MBIE Curious Minds supported the production of an educational leaflet from the project, which can be found on the Otago Participatory Science Programme website <http://scienceintoaction.nz>.

Through the project children have learned about the nutritional information labels and how to read the amount of sugar contained in a certain product.

"Physically weighing the sugar content and placing it in plastic bags was an eye opener for the kids," Dr Loch says. "They were also surprised on the amount of physical activity required to "burn" the calories contained in certain foods. For example, they had to run around the school grounds for 10min to use the energy content of only one apple. Kids were also impressed with the sugar content of "so-thought" healthy products such as fruit juices, smoothies and sports drinks."

Experiments on the acidic nature of certain drinks were also interesting to the pupils, she says.

"If you chose a sugar-free or diet version of a fizzy drink, for example, it is still acidic and this can cause all sorts of dental problems."

The team expects this initiative will result in an increase in science engagement, better oral health and improved nutritional choices for the pupils, whānau and the broader community.



Outreach activities at NZ International Science Festival, Dunedin 2018.

Stories from our research

“Giant” problem looms for oral health of ageing New Zealanders

Urgent attention needs to be paid to frail older New Zealanders’ oral health, a University of Otago study has highlighted.

In a world-first, Otago researchers surveyed the oral health of 987 people living in aged residential care and found those with dementia, and older men in general, have dirtier and more decayed teeth.

Otago Head of Department of Oral Sciences and lead author, Professor Murray Thomson (*right*) describes poor oral health as one of the “geriatric giants” with the situation a “major clinical and public health problem which is going to get worse”.

Older people have higher rates of cognitive and physical impairments that can adversely affect their oral self-care and complicate the provision of oral care, he says.

“Neither the aged care sector nor the dental profession, in most countries, is prepared. Not only do we have more and more older people every year, but more and more people are entering old age with their own teeth, rather than full dentures, as was the situation just a couple of decades ago.

“In some ways, dentistry has been a victim of its success – we have long emphasised the idea of ‘teeth for life’ without much thought to what happens towards the end of life.

“We also now know that half of those in old age will end up in residential aged care, and that more and more of those will have some form of dementia.”

Professor Thomson believed that “slow progress” was being made in the area.

“It’s a very complex situation involving a lot of players – the aged care sector, the Ministry of Health, the dental profession, and the public. An encouraging sign is the inclusion of oral health in New Zealand’s Healthy Ageing Strategy. That’s a starting point, but there is a lot of work to be done,” he says.

Of those examined in the study (representative of the more than 14,000 New Zealanders living in aged care), recently published in the journal *Gerodontology*, about half had severely impaired cognitive function, and more than a third required fillings or extractions.

Those with severely impaired cognitive function had greater numbers of teeth with decay. They also had higher oral debris scores, reflecting poorer daily oral hygiene care.



Professor Thomson says greater rates of tooth decay can result in dental and facial infections, poorer quality of life, malnutrition and difficulties in communication.

The researchers also found that even the most cognitively impaired participants were able to be examined fairly easily, meaning that regular, routine removal of oral debris by carers should not be difficult.

“The issue that we currently face is that much of that debris removal is not being done, and this, along with frequent exposure to sugary, over-processed meals and snacks, and poor salivary function, is enabling plaque and dental caries to flourish in aged residential care populations.”

For those wanting to improve or maintain their oral health, Professor Thomson has some simple advice: brush twice daily with fluoride toothpaste; clean carefully between the teeth at least two to three times per week; avoid having sweet drinks or snacks between meals (and that includes sugar in tea or coffee – it takes only a couple of days to get used to not having it); and avoid smoking.

“For people who have poor oral health in middle age, it is not going to be any better in old age, and an honest, open conversation with a dentist about the options, which may include complete extraction, may be a very good idea.”

High unmet need for dental care among Syrian refugees

High unmet need for dental care is causing pain, embarrassment, worry and reducing quality of life among Syrian refugees, new University of Otago research shows.

The research, based on a survey of 62 adult Syrian refugees resettled in Dunedin over the past few years, found a very high level of unmet oral health need, while financial issues are perceived as a barrier to them receiving oral health care.

Lead researcher Associate Professor Jonathan Broadbent from the Faculty of Dentistry, says little is known about oral health among Syrian refugees.

While the research did not investigate whether similar refugees in other parts of the country are experiencing the same problems, he expects the situation to be similar nationally.

As a result of the evidence collected, he is now calling for a national protocol to standardise what dental care services are available and funded and how they should be accessed.

“Access to post-settlement oral health care for refugees is currently unsatisfactory, and dental clinicians and refugees are both placed into a different situation when pathways are unclear,” Associate Professor Broadbent says in the research paper recently published in the *NZ Dental Journal*.

“Oral health care should be accessible to refugees and other at-risk population groups to ensure they enjoy good oral health and overall well-being, and that their human rights are being realised,” he says.

“It is concerning that more than 70 per cent of former refugees reported current dental pain and fewer than 40 per cent had a dental check-up within the 18 months since their arrival.”

The majority perceived their oral health as “poor” or “very poor”. Many made additional comments about their dental problems. One participant stated: “I am very tired from all the dental problems I have, no one contacted me for dental treatment, please help me.” Another stated: “I want treatment because I feel self-conscious and have no confidence to smile. I feel like I have a bad smell all the time from my mouth.”

In New Zealand, newly-arrived refugees spend six weeks on an orientation programme at the Mangere Refugee Settlement Centre in Auckland. Their orientation includes an oral health screening and treatment for emergency dental problems.

Almost all refugees qualify for limited financial assistance for dental care in New Zealand. However, nearly half reported they had not received assistance and many were not aware of the options available to them.

This research did not involve collection of clinical examination data, which Associate Professor Broadbent says should be done in future research to better quantify dental care need requirements nationally among Syrian refugees.

However, this lack of clinical data should not stand in the way of efforts to improve care, he says. As a practising dentist who has treated some of these patients, he characterises their dental health needs as very high.

Local dentists pick up the pieces when ‘dental tourism’ goes bad

New Zealand dentists are increasingly having to provide remedial treatment where things have gone wrong for “dental tourists” who travel abroad for dental work.

Overseas travel for dental treatment is said to be the most prevalent form of medical tourism internationally with people from high-income countries seeking treatment in low-income countries. Each year about 40,000 to 50,000 patients from the UK seek dental care abroad and increasingly, it is becoming a phenomenon in New Zealand too.

Researchers at the University of Otago have found that typically New Zealanders seek dental treatment abroad because it is cheaper and they can also holiday in destinations such as Asia.

However, while for some the treatment is successful and is combined with a satisfying tourist experience, for others the treatment fails and the tourists seek remedial work once back in New Zealand.

The University of Otago survey of 337 New Zealand dentists in 2016 showed most (96 per cent) had encountered dental tourists at least once or twice a year, usually because they required remedial treatment.

Published recently in the *Journal of Tourism Management*, the research was carried out by Associate Professor Brent Lovelock from the Department of Tourism, Senior Research Fellow Dr Kirsten Lovelock from the Department of Public Health, and Faculty of Dentistry Professor Karl Lyons.



Left: University of Otago research has found that New Zealand dentists are fixing increasing numbers of 'unsuccessful dentist treatments due to 'medical tourism.' Image: Creative Commons.



Right: Professor Karl Lyons, a co-author of the study.

Dentists identified a range of issues arising from their patients receiving treatment abroad. The most important issue was a lack of follow-up maintenance and a lack of availability post-treatment. About half of the respondents identified lack of treatment planning and lack of treatment records to be issues.

One dentist explained they saw a patient in pain who had a full mouth of crowns and bridges.

"I wasn't prepared to treat the patient as the quality of work was absolutely appalling. The dentition had been absolutely wrecked and I wanted nothing to do with it," the dentist said.

Many dentists were concerned that patients are unaware of the poor quality of work often being carried out.

"Patients are unaware of the poor quality of the work they receive and the difference in standard of care compared to New Zealand dentistry. Patients are often over-treated and inappropriately treated with irreversible damage to their teeth and no apparent discussion or awareness of treatment options," another dentist said.

Thailand was the most commonly noted country of treatment, with nearly 90 per cent of dental patients having been treated there, followed by India and Indonesia.

While about half of the dentists acknowledged dental tourism provides access to affordable dental treatment, very few (6 per cent) felt it enhances dental health outcomes for their patients and even fewer (1.9 per cent) would recommend it to their patients. A considerable number (21.8 per cent) agreed that dental tourism should be discouraged due to its negative impact upon New Zealand's dental healthcare system.

When asked to rate the impact on dental care provision in New Zealand of providing remedial dental treatment for returned tourists, just over 60 per cent considered this to be more than at least "moderately significant".

The most common type of treatment sought abroad was crowns, while implants and bridges were other commonly observed treatments.

The Otago researchers acknowledge the perceived issue of "professional protectionism" with their study, in that dentists may consider the impact upon their practices by the provision of care abroad. So, they specifically asked dentists about the perceived impacts of dental tourism on their practice's income.

While a number of respondents (about 15 per cent) considered dental tourism would impact negatively on their practice incomes, a small number (6 per cent) felt it would actually increase their practice's income due to the increased demand for remedial treatment.

New Zealand Dental Association Chief Executive Officer Dr David Crum says dental tourism exists and will appeal to a small sector of New Zealanders.

"It comes with risks most often related to quick care supplied over a very short duration by a practitioner unknown to the patient."

Most often the dental care required is at the advanced, and more expensive, end of the spectrum, and often not discovered to be poorly implemented until months later after the patient has returned home, Dr Crum says.

The New Zealand Dental Association continues to believe patients are best served by establishing a long-term care relationship with a dentist who meets mandatory New Zealand standards in their own community.

'Killer' toothaches likely cause misery for captive orca

An international research team including Dr Carolina Loch of the SJWRI has undertaken the first in-depth investigation of the teeth of captive orca (killer whales) and have found them a sorry state, which raises serious concerns for these majestic mammals' overall health and welfare.



Anyone with a toothache knows how painful and distracting that can be - in orca which have around 48 large teeth, a sore tooth is likely no less painful or debilitating than for a person. Now, a new international study published in the journal *Archives of Oral Biology*, found that every individual examined had damaged teeth.

Study lead author Professor John Jett of Florida's Stetson University, an ex-orca trainer, says the team investigated 29 orca owned by one company and held in the USA and Spain.

"Every whale had some form of damage to its teeth. We found that the more than 65 per cent possessed moderate to extreme tooth wear in their lower jaws, mostly as a result of chewing concrete and steel tank surfaces."

Additionally, the researchers found that more than 61 per cent of the orca they studied have "been to the dentist" to have their teeth drilled. Officially termed a "modified pulpotomy", a hole is drilled into the tooth to extract the soft pulpy tissue inside.

Study co-author Dr Carolina Loch specializes in the dentition of whales and dolphins, and says that unlike

Captive orca have terrible teeth, mostly caused by chewing concrete and steel tank surfaces, according to research that photographed the mouths of 29 orca kept in captivity. Image: Ingrid Visser.

us, the resultant hole is not filled or capped, but rather is left open for the rest of the animal's life, requiring daily flushing with chemicals to keep the teeth empty of food and bacteria in an attempt to manage resulting infection.

"Once the tooth gets worn to the point where the pulp is exposed this opens up a channel for disease and infection, so the staff then drill the teeth," Dr Loch says.

Dr Jeff Ventre, another of the study authors, also an ex-orca trainer and now a medical doctor, says that he had drilled orca teeth in his former work.

"Teeth damage is the most tragic consequence of captivity, as it not only causes morbidity and mortality in captive orcas, but often leads to chronic antibiotic therapy compromising the whale's immune system, as we saw recently with the orca known as Kasatka," Dr Ventre says.

Dr Loch added that a drilled tooth is severely weakened and if any other trauma occurs, fractures will happen.

"We have documented more than 60 per cent of the second and third teeth of the lower jaws were broken and this high number is likely linked to the drilling."

During his time as a trainer, Dr Ventre says that he had witnessed "whales breaking their teeth on steel gates while jaw popping. Small tooth fragments were then collected below the gate while diving the pool".

Jordan Waltz, an investigative researcher and co-author noted that "the damage to the teeth of these animals is so severe that most individuals can be identified by the specific fractures and tooth wear alone, much like forensic pathologists use for identification of humans post-mortem."

Dr Ventre also noted that "the obligatory daily teeth irrigations render the compromised orcas poor candidates for full release", should companies ever make the transition to look at rehabilitation for their captives.

Co-author Dr Ingrid Visser, a New Zealand-based scientist who has studied orca in the wild for more than three decades, has long been advocating for an end to orca captivity.

"We know that confining them in tanks is bad for the animals and this research now gives us some hard numbers to illustrate just how their health and welfare is compromised.

"Given how big the root of an orca's tooth is and that orca have a nervous system similar to ours, these injuries must be extremely painful.

"Compared to free-ranging orca, the teeth of captive orca are incredibly compromised and you just don't see this type or level of damage in the wild," says Dr Visser.

Dr Loch points out that "dentists have long said that oral health is a measure of general health as our mouths are the gateway to our body," and she believes that this is likely the same for orca.

Professor Jett concludes: "We have documented that tooth damage starts at a very early age in captivity and that all the orca in the study have issues with their teeth. Teeth are incredibly important to the overall health of an animal, and the results of our study should raise serious concerns for the health and welfare of captive orca."

Key findings

- Using high-resolution photographs, individual teeth in the mandible and maxilla of captive orca were scored for coronal wear, wear at or below the gum line, fractures, bore holes and absence.
- Dental damage was commonly observed across all captive whale cohorts, with damage beginning early in a whale's captive life.
- Forty five percent of whales exhibited "moderate" mean mandibular coronal wear, and an additional 24 per cent exhibited "major" to "extreme" wear.
- More than 61 per cent of mandibular teeth 2 and 3, and 47 per cent of mandibular tooth 4, exhibited evidence of having undergone the 'modified pulpotomy' procedure.
- Aggression amongst the whales and repetitive oral stereotypies such as biting on hard tank surfaces likely contributed to the tooth pathology observed.

John Jett, Ingrid N. Visser, Jeffrey Ventre, Jordan Waltz, Carolina Loch, Tooth Damage in Captive Orcas (*Orcinus orca*), *Archives of Oral Biology* Volume 84, December 2017, Pages 151-160

doi.org/10.1016/j.archoralbio.2017.09.031

SJWRI forensic scientists have challenging but rewarding role in repatriation mission

The remains of 27 New Zealand Defence Force (NZDF) personnel and one child have been reunited with their families, thanks to a team which included University of Otago archaeologists, bioarchaeologists and forensic odontologists.

The group is part of project Te Auraki ("The Return") under which NZDF personnel buried overseas after 1 January 1955 are being brought home to New Zealand, following a change in Government policy.

The NZDF deployed an expert disinterment team to carry out the repatriation and identification process. The team was headed by Disinterment Team Leader Lieutenant Colonel Charmaine Tate, and worked alongside the Malaysian Armed Forces who provided logistic and forensic support.

"There was an overwhelming feeling of working together for a common goal that transcended personal agendas and career ambitions which can plague academic projects."

Professor Hallie Buckley of Anatomy was the lead forensic anthropologist for the disinterment team and described her involvement as "humbling, exhausting, and rewarding".

The remains, returned at a ramp ceremony at Auckland International Airport yesterday, belonged to NZ Army soldiers who were serving in Malaysia, Thailand, and Vietnam when they died. The child was the son of a member of the NZ Army.

Along with Professor Buckley, seven other Otago scientists made up part of the disinterment team. They included Professor Warwick Duncan, Professor Darryl Tong and Dr Angela Clark of the Sir John Walsh Research Institute and Faculty of Dentistry, along with Dr Peter Petchey of Anthropology and Archaeology, and Drs Rachel Scott, Rebecca Kinaston and Anne Marie Sohler-Snoddy of Anatomy.

"All of the team is highly skilled and each played an integral part in getting the job done," Professor Buckley says.

In order to ensure positive identification of the personnel, the bioarchaeologists and archaeologists were tasked with excavating and analysing the skeletal remains, while the forensic odontologists carried out detailed examinations, comparing remains with original dental records provided by NZDF.

The biggest challenge they faced was carrying out gruelling physical work in very hot and humid conditions.



University of Otago scientists joined NZDF personnel at a blessing ceremony at Terendak Military Cemetery before beginning the disinterment work. Photo: NZDF.

One of the highlights, however, was the Otago contingent working with the NZDF and Malaysian medical and forensic team on such a positive task.

"There was an overwhelming feeling of working together for a common goal that transcended personal agendas and career ambitions which can plague academic projects. It was an enormously gratifying and liberating experience for me," Professor Buckley says.

The project was especially poignant for Professors Duncan and Tong as the forensic odontologists are also both senior Reserve Force officers in the NZDF.

"This project is about making sure the inequalities and inconsistencies of the past are put right and everyone is treated the same, regardless of wealth, rank or cause of death."

"The purpose of this operation was to return the remains of those who have served New Zealand abroad, to their relatives and descendants. We get a great deal of job satisfaction in achieving this and hopefully bringing some closure to these families," Professor Duncan says.

"Both Darryl and I were grateful to be invited by the NZDF for this historic and unique operation. We both feel that our knowledge of forensic dentistry and our ability to contribute to disaster victims' identification in New Zealand and abroad, has been considerably enhanced by the knowledge we gained during Operation Te Auraki."

Royal New Zealand Air Force Group Captain Carl Nixon says it is important to return the fallen personnel in a dignified manner in accordance with NZDF's contemporary cultural, religious and military protocols.

"Today we honour the memory of a child, and the sacrifice of 27 soldiers who died serving their country overseas. We're bringing them home to their families who have waited more than 60 years for this moment," Group Captain Nixon says.

"This project is about making sure the inequalities and inconsistencies of the past are put right and everyone is treated the same, regardless of wealth, rank or cause of death."

The first portion of Te Auraki was completed in May, with the remains of three personnel repatriated from Fiji and American Samoa.



Planning is underway for the next two portions of the project, which will see two personnel repatriated from England in September, and two from the Republic of Korea in October.

Dentistry staff make a major contribution to *Periodontology 2000* special issue

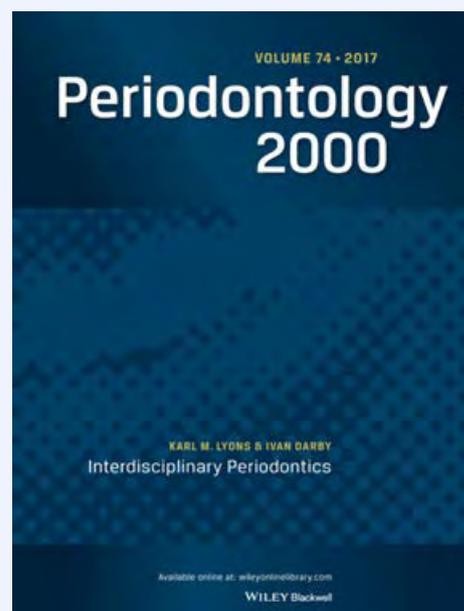
Staff from the Faculty of Dentistry's Sir John Walsh Research Institute made a major contribution to the May 2017 volume of *Periodontology 2000*, the top ranked journal for dentistry.

The focus of the volume is interdisciplinary periodontics, and the articles included discuss the interactions and the interrelationship between periodontal tissues/periodontal diseases and endodontics, fixed prosthodontics, implant dentistry, aesthetics, gerodontology, radiology, orthodontics, pediatric dentistry, oral and maxillofacial surgery, oral pathology, special needs dentistry and general medicine.

Of the 13 articles in the volume, 7 have been authored by Otago academics, with contributions from 13 current staff and 3 recent staff.

A recent description of the volume was "No other journal has ever done such a comprehensive job of delineating Interdisciplinary Periodontics".

The volume is available online at onlinelibrary.wiley.com/doi/10.1111/prd.2017.74.issue-1/issuetoc.



Our programmes

1961

The Walsh Building
opens to the public

The Walsh Building is opened by the Minister of Education, the Hon. Blair Tennant. The new building is an aid to training, treatment, and research in dentistry.



Biomechanics & Oral Implantology

Programme leaders

Associate Professor Neil Waddell (Biomechanics and Biomaterials)

Professor Warwick Duncan (Oral Implantology)

Programme overview

Within the area of biomechanics and biomaterials, we conduct experimental and observational research in:

- Dental materials - development of new dental restorative materials for dental CAD/CAM systems.
- The use of 3D printing in the fabrication of dental appliances and prostheses.
- Cranio-facial biomechanics - prosthodontic failure mechanisms and adhesion of dental restorations and materials.
- Sub-concussive brain injury research - *in vitro* modelling of the effects of blunt force trauma to the head on accumulative damage to the brain.
- Dental hard tissues and evolutionary oral biology research - characterising animal teeth and other biological materials to elucidate the biology, evolution and interactions with the environment of fossil and recent species.
- Forensic biology - *in vitro* modelling of blunt force trauma, forensic odontology, wounding and ballistic blood splatter analysis, development of simulant materials for forensic modelling.

Within the area of oral implantology, our research focuses on:

- Grafting and regenerative therapies.
- Surface treatments of implant fixtures for enhanced osseointegration.
- The effects of implant fixture corrosion products on periodontal structures.
- Developing ultrasonic diagnostic devices for dentistry.
- Silver and gold nanomaterial technology group - developing nanoparticles for use in a range of therapeutic technologies.
- *In vitro* modelling of masticatory forces on implant overdentures, their supporting sub-structures and surrounding bone.

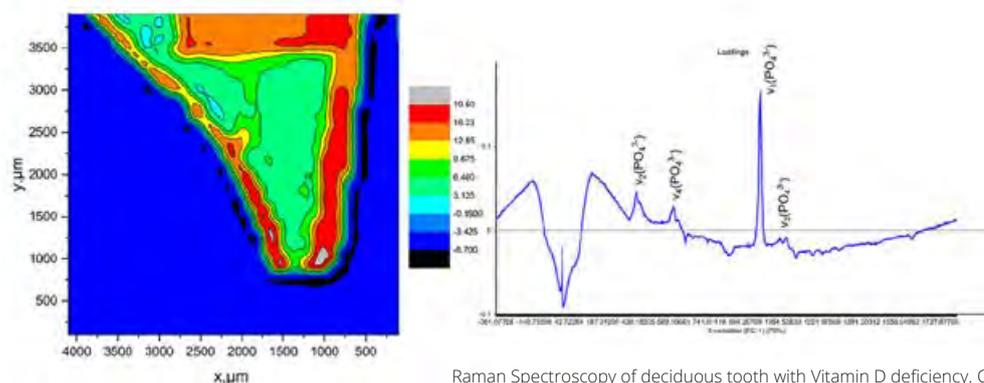
KEY PERSONNEL

Staff

Prof Warwick Duncan
Prof Karl Lyons
Prof Paul Brunton
Prof Darryl Tong
Assoc Prof J Neil Waddell
Assoc Prof John Broadbent
Assoc Prof Andrew Tawse-Smith
Assoc Prof Dawn Coates
Dr Peter Cathro
Dr Don Schwass
Dr Sunyoung Ma
Dr Carolina Loch
Dr Kai Chun Li
Dr Joanne Choi
Dr Gemma Cotton
Dr Tanmoy Bhattacharjee
Ludwig Jansen van Vuuren
Wendy Jansen van Vuuren

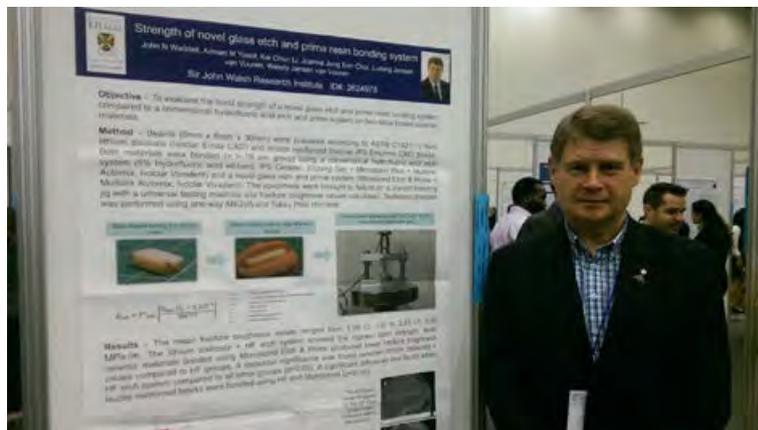
Postgraduate students

Christina Gee
Dina Abdelmoneim
Asar Badarnesh
Huda Mohammed
Abdula Barazanchi
Vidya Mudliar
Lisa Falland
Janine Tiu
Andrew Tawse-Smith
Donald Schwass
Sunyoung Ma
Ludwig Jansen van Vuuren
Veivakatorocaketaki Masi Ovin



Raman Spectroscopy of deciduous tooth with Vitamin D deficiency. Courtesy Dr C Loch.

Right: Assoc Prof Neil Waddell presents dental biomaterials research during a poster session at IADR 2017 in San Francisco.



Collaborations

University of Otago

Department of Geology
 Department of Chemistry
 Department of Anatomy
 Department of Zoology
 Department of Marine Sciences

National

Department of Mechanical Engineering, University of Canterbury

Van Der Veer Institute, University of Canterbury

Department of Engineering Sciences, University of Auckland

Department of Mechanical Engineering, University of Auckland

Forensic Science, Department of Environmental Science and Research

South Island Brain Injury Research Group (SIBIRG)

International

School of Dentistry, University of Adelaide

Impact and Armour Group, Cranfield University

Defence Academy of the United Kingdom, Shrivenham

University of the Witwatersrand, Johannesburg

South African Nuclear Energy Corporation in Palindaba

Tokyo University of Agriculture and Technology, Tokyo

Facharzt für Rechtsmedizin, Institut für Rechtsmedizin, Leipzig, Germany

University of Kent, Canterbury
 Université Bordeaux

Hampden-Sydney College USA

South Australian Museum, Adelaide

CENPAT Puerto Madryn, Argentina

Universidade Federal de Santa Catarina, Brazil

Current research

Activity 1. Dental Materials.

Description: Evaluating specific issues associated with the range of dental materials from composite resin systems to advanced ceramics. One of the groups has a focus on mechanical properties of dental ceramics and their reasons for failure, with a particular interest in fractography and analysis of failure in brittle materials. A more recent novel area is the silver and gold nanomaterial technology group, which is developing nanoparticles for use in a range of therapeutic technologies.

Aim: Provide basic information about these materials that enables a better basis for understanding their usage in clinical settings and the development of new treatment technologies and materials.

Source(s) of funding: Neurological Foundation Research Grant, Maurice and Phyllis Paykel Trust, ANZAOMS Research and Education Trust, New Zealand Dental Research Foundation, Fuller Scholarship for Dentistry, Otago Innovation, University of Otago Research Grant, Sir John Walsh Research Institute and proprietary funding.

Activity 2. Sub-concussive Brain Injury.

Description: Concussive and subconcussive injury is a global phenomenon, which has been likened to a silent epidemic due to the large numbers of young people who sustain head injuries in sports and military activities. The objective of this research is to quantify the impact forces transmitted through the various levels of scalp, skull and brain at values below what is predictive of concussion. Once this data is obtained, clinical evaluations of neurologic function using established methodology can be used to correlate the effects of these impact forces for further research, but the main objective for this research study is the quantification of these forces.

Aim: Can the impact forces involved with subconcussive head injury be quantified in order to determine a threshold or range of impact forces that may be predictive of sub-concussion?

Source(s) of funding: Neurological Foundation Research Grant, Maurice and Phyllis Paykel Trust, University of Otago Research Grant. Division of Health Sciences Sandpit Funding. ANZAOMS Research and Education Trust.

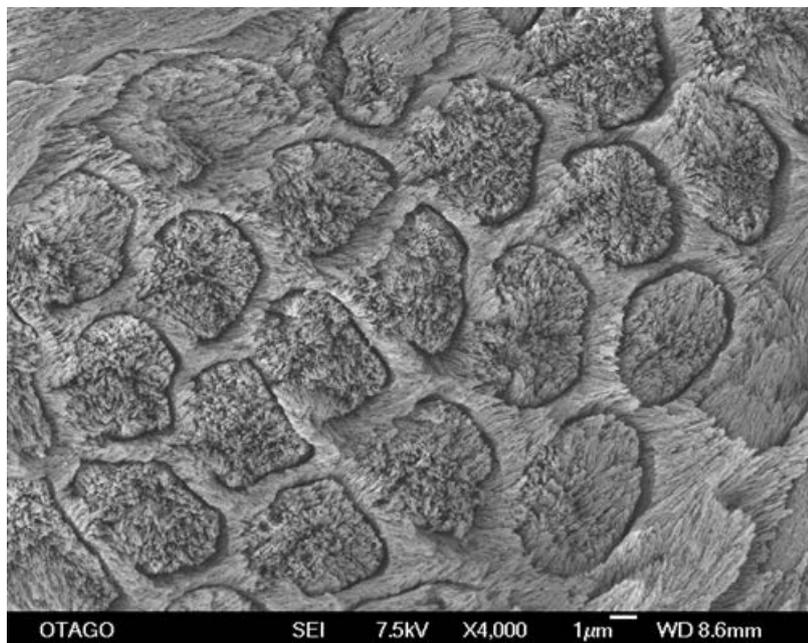
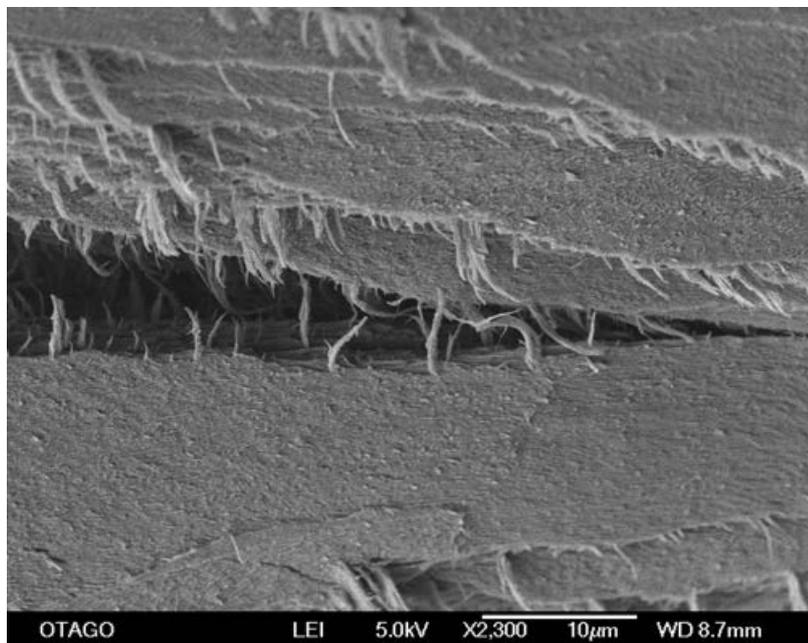
Activity 3. Soft and Hard Tissue Biomechanics and Forensic Biology.

Description: Investigating the basic properties of skin, teeth, broad aspects of evolutionary oral biology, comparative dental morphology and bone related to the craniofacial region and forensic issues.

Aims: Teeth and bone are special as they preserve a record of their formation in the adult end-product. Hence, an examination of adult morphology can be used to reveal some of the processes that were involved, as well as some of the perturbations of such processes. By studying teeth and other biological materials we are attempting to understand the biology, life history, evolution and interactions with the environment of fossil and recent mammal species. Comparative dental morphology and ultrastructure are key elements of this activity.

This knowledge can then be linked to clinical findings that can result in better therapeutic outcomes. Our research has mainly been focused on the structure and function of enamel and dentine in different species, the forces generated during swallowing, and the behaviour of skin and bones during events such as ballistic and blunt force trauma.

Sources of funding: New Zealand Dental Research Foundation, Leverhulme Fund (UK), Lottery Health Grant, University of Otago Research Grant, OMRF Laurensen Award, MBIE Unlocking Curious Minds Fund.



This page: Electron micrographs of dental structures in marine mammals, courtesy Dr C Loch.

Top: Microstructure of baleen, the grinding plates made of keratin fibres that are present in place of teeth in plankton-feeding baleen whales.

Bottom: Enamel prisms in the teeth of sea otters, visualised under electron microscopy.

Activity 4. Oral Implantology and Associated Superstructures.

Description: Our research teams have expertise with respect to conducting clinical (human) and preclinical (animal) trials and laboratory-based research relating to oral implants. Currently, funded research is being conducted into different oral implant systems, materials, surfaces, superstructures, and surgical and restorative protocols, as well as supporting biological and regenerative products. Our research encompasses immediate placement and/or loading of single implants and implant-supported over-dentures, fit of zirconia prostheses, implant analysis using micro-CT, and analysis of different implant systems and bone placement grafts in sheep femur and maxillary sinus models, in vitro modelling of strain distribution within implant overdentures and their supporting sub-structures and bone, in vivo analysis of implant fixture corrosion.

Aims: Evidence-based treatment that reduces the interval between oral implant placement and loading, by optimising the implant design and the surgical and prosthodontic protocols and materials.

Source(s) of funding: New Zealand Dental Research Foundation; JF Fuller Foundation; International Team for Oral Implantology ITI Switzerland; Straumann AG, Switzerland; NobelBiocare Australia; Southern Implants, South Africa; Korea Science and Engineering Foundation (KOSEF), Megagen Co Ltd., South Korea; Osstem Co. Ltd, South Korea; Neoss Australia Ltd; Keratec Ltd. New Zealand.

Funding highlights

2018

\$14,970 NZ Dental Research Foundation
Bonding universal dental adhesive resin to developmentally hypomineralized enamel. (PI – Ekambaram M. CI - Yiu CKY (UHongKong), Waddell JN, Li KC, Lowrey S, Boyd D, Lee Y)

\$14,970 NZ Dental Research Foundation
Development of a simulant model for clinically relevant testing of implant- and natural tooth-supported all-ceramic restorations [Phase Two]. (PI – Jansen van Vuuren L, CI – Waddell JN, Duncan WJ, Broadbent J)

\$120,000 Lottery Health Research - Equipment
UFW200 Universal Multi-Function Wear Test System. (PI – Choi J, CI – Waddell JN, Loch C, Duncan WJ).

\$20,000 SJWRI TK Sidey Early Career Research Fund
Development of novel antimicrobial, wear and corrosion resistant coating for teeth and dental restorations. (PI: Choi J. CI – Duncan WJ and Waddell JN)

£294,391 Leverhulme Trust
Biorhythm of Childhood Growth. (PI Mahoney P (University of Kent UK). CI - Loch C, Guatelli-Steinberg D (Ohio State University, USA), Bayle P (Universite Bordeaux, France).

\$47,000 Lottery Health Research - Projects
A novel approach to treating root caries in the elderly using chlorhexidine-modified glass ionomer cements. (PI Brunton PA. CI - Lyons K, Loch C, Heng N, Cannon R, Ratnayake J, Ahmed HM)

\$25,931 University of Otago Research Grant
Dolphin teeth as a biomonitoring tool of heavy metal exposure. (PI Loch C. CI – Palin M, Kemper C, Taylor M, Stockin K, Duncan WJ).

2017

\$19,295 SJWRI TK Sidey Early Career Research Fund
Using teeth to understand mammal biology and evolution. (PI Loch C).

\$13,700. MBIE Otago Participatory Science Platform
Sugar in your diet: kino te pai!. PI Loch C and Cannon R. CI - Foster Page L, Beckett D, Te Morenga L, Kawe-Small T.

\$41,000 OMRF Laurensen Awards
What are the dental consequences of vitamin D deficiency in pregnancy and infancy? (PI - Wheeler B. CI - Beckett D, Loch C, Mahoney E.

\$26,800 Cure Kids Innovation Seed Grant
Development of tooth-coloured shell crowns to treat dental caries in children. (PI – Choi J, CI – Waddell JN, Foster-Page L, Duncan WJ).

\$23,000 University of Otago Research Grant
Development of a novel tooth-coloured shell crowns to treat dental caries in children. (PI – Choi J, CI – Waddell JN, Foster-Page L, Duncan WJ).

\$36,680 University of Otago Research Grant
Developing a simulant skull model with accurate mechanical properties using 3D-printed polymers. (PI – Li KC, CI – Waddell JN, Tong D, Hammer N, Duncan WJ).

Key publications

Aarts, J. M., Jansen van Vuuren, W.-A., Withy, K. E., Choi, J. E., & Waddell, N. J. (2017). A pilot study on the influence of two reinforcing materials (glass fibre mesh and electro-spun nylon nano fibres) on the flexural strength of a heat-cured poly (methyl methacrylate) denture base resin. *New Zealand Dental Journal*, 113(3), 11-15.

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Barazanchi, A., Li, K. C., Al-Amleh, B., Lyons, K., & Waddell, J. N. (2017). Additive technology: Update on current materials and applications in dentistry. *Journal of Prosthodontics*, 26(2), 156-163. doi: 10.1111/jopr.12510

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Clinical & Translational Research

Programme leader

Professor Warwick Duncan

Deputy Programme Leader: Dr Mo'men Atieh

Programme overview

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 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.



KEY PERSONNEL

Staff

Professor Warwick Duncan
Professor Mauro Farella
Professor Paul Brunton
Professor Darryl Tong
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 Mo'men Atieh
Dr Joanne Choi
Dr Gemma Cotton
Dr Tanmoy Bhattacharjee
Dr Jithendra Ratnayake
Dorothy Boyd

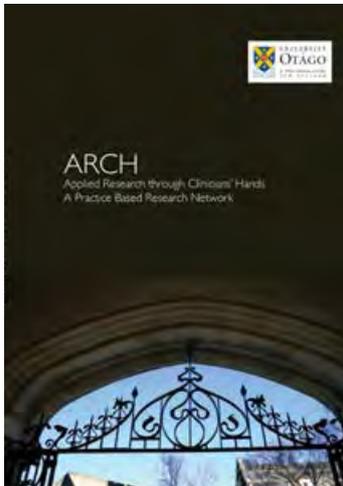
ARCH dental practice-based research network

Dr Lara Friedlander
Suzanne Hanlin

Postgraduate students

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

Clinical facilities within the new Faculty of Dentistry Clinical Services Building



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.

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.

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)

Current research

Novel therapeutic agents

- Silver nanoparticles (**Silverbone** project, more details on facing 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 (over page) – *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, facing page) – benchtop, preclinical animal trial, clinical trial

Professor Warwick Duncan 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.

Aside from his University research, Professor Duncan runs a private practice where he experiences problems first hand.

"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 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.

"Molteno uses cow bone as the basis of a grafting material in eye sockets and we use it for dental applications. An existing product uses New Zealand beef bones, which are exported to a company in Switzerland where they turn them into grafting material and send that back to us at a high mark-up.

"This doesn't make sense when beef bone is a by-product of our agricultural industry and just goes to make blood and bone instead of being turned into a high-value product. We need to improve upon that material, make it ourselves and get costs down."

The cost of dental treatment is increasingly important since research revealed significant links between oral and general health.

One of the team's main challenges is fighting infection, which is particularly prevalent in oral work where there is a higher likelihood of damage from bacteria than in ophthalmic and orthopaedic surgeries. There's also increasing concern about rising bacterial resistance to antibiotics.

Working with manufacturer Molteno and nano-scientist Meledandri, Duncan's 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.

Cell culture work is now fine-tuning the new graft material to balance maximum protection from infection and maximum healthy bone growth.

"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."

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.

"Both SilverBone and UltraD3 are getting to very exciting stages, with likely results expected in the next couple of years. It's really cool science and it's really enjoyable."

Silverbone and UltraD3 are supported by the NZ Ministry of Business, Innovation and Employment's Endeavour Fund.

Development of novel tooth-coloured shell crowns to treat dental caries in children

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.

This project is supported by Cure Kids, Hitem Co. Ltd. and the University of Otago Research Committee.

Funding highlights

\$91,887; "Bovine-derived lactoferrin in a degradable PVA-tyramine hydrogel for oral bone regeneration in a tooth socket model". Medical Technology Centre of Research Excellence Seed Fund; (W Duncan, D Musson, K Lim, J Cornish, T Woodfield) 2018.

\$25,000; "EMG-Guard: a smart-phone assisted wireless EMG device for small superficial muscles". Medical Technology Centre of Research Excellence Seed Fund; (M Farella, R Cannon, M-L Huckabee, M Paulin) 2017

\$46,482; "A novel approach to the treatment of root caries in the elderly: a clinical and molecular investigation of chlorohexidine-modified glass ionomer cements". New Zealand Lottery Grants Board (P Brunton, H Ahmed, R Cannon, N Heng, C Loch, K Lyons, J Ratnayake) 2018

\$9,463; "Managing elderly patients requiring endodontic treatment - a New Zealand practice based research study". New Zealand Dental Research Foundation (NZDRF) and Continuing Dental Education Trust (L Friedlander, N Chandler, B Daniel, P Hamadani) 2018

\$15,000; "Development of an ovine model for investigating effects of orthodontic tooth movement". NZDRF (Farrar R, Farella M, Duncan W, Antoun J, Melsen B) 2018

\$49,458; "A novel approach for monitoring eating behaviour in children". Cure Kids Innovation Seed Fund (M Farella, G Idris, B Galland, C Smith, R Taylor, C Robertson) 2018

\$10,000; "Development of a simulant model for clinically relevant testing of implant-and natural tooth-supported all-ceramic restorations (Phase Two)" NZDRF (L Jansen van , J Broadbent, W Duncan, JN Waddell) 2018

\$220,000 (AUD); "Titanium-zirconium narrow (3.3mm) versus standard (4.1mm) diameter dental implants for replacing single posterior missing teeth". ITI Research Grant (M Atieh, W Duncan, A Tawse-Smith, S Ma). 2017

\$210,254; "Evaluation of an Endoform membrane combined with Bio-Oss bone graft in a sheep tooth extraction model." Aroa Biosurgery Ltd. (W Duncan) 2017

\$26,800; "Development of a novel tooth-coloured shell crowns to treat dental caries in children ". Cure Kids Innovation Seed Fund (J Choi, W Duncan, L Foster Page, JN Waddell) 2017

\$150,000; "Healing mechanisms in stem-cell driven regeneration of deer antler". Velvet Antler Research NZ (D Coates et al) 2017

\$13,425; "Effect of different surfactant concentration on bacterial power and shelf life". Dentalife Australia Pty Ltd (P Cathro, O Gonzalez) 2017

Key publications

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Patents

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Craniofacial Research

Programme leader

Professor Mauro Farella

Deputy Programme Leader: Dr Joseph Antoun

Programme overview

The Craniofacial Research programme encompasses a diverse range of exciting fields, including the basic and molecular sciences relevant to craniofacial growth, the impact of malocclusions on oral health, jaw function, self-esteem, psychological wellbeing, and the understanding of the peripheral and central mechanisms of orofacial pain and jaw dysfunction with their clinical correlates.

Several research approaches are used to study topics relevant to craniofacial research, including cell response to mechanical loading, animal models, and clinical genetics. The latter focuses on identifying genetic markers for some dentofacial anomalies which could potentially provide us with a clinically important window of opportunity to predict abnormal growth patterns at an early age and, possibly, to provide personalized orthodontic treatments.

An additional area of active research is focusing on the development of novel treatment strategies for clinical problems such as craniofacial syndromes, jaw discrepancies and misaligned teeth. Furthermore, the impacts of craniofacial anomalies and smile problems are quantitatively and qualitatively assessed at population and individual level using survey methods including social media. Social media enables us to gather opinions from the public about the importance of smiles for individuals themselves and also the perspective of their peers.

Craniofacial Research examines mastication and jaw kinematics, bruxism and non-functional oral behaviours, sleep disordered breathing including snoring and sleep apnea, intra-oral tongue pressure, dysphagia, tooth wear, eating behaviour, and novel food products. We are currently using wired and wireless sensors to monitor intraoral pH, temperature, and jaw activity for the purpose of identifying and evaluating ways of overcoming orofacial pain, dental wear, jaw dysfunction, jaw clicking sounds, snoring, and obstructive sleep apnea. We also use monitoring equipment to improve the quality of sleep in New Zealand children and adults.



Dr Li Mei, Professor Mauro Farella, Danielle Hodgkinson and Dr Austin Kang.

KEY PERSONNEL

Staff

Professor Mauro Farella
Dr Joseph Antoun
Florence Bennani
Prof Richard Cannon
A/Prof Rohana De Silva
Professor Mauro Farella
Dr Winifred Harding
Dr Hannah Jack
Dr Austin Kang
Dr Carolina Loch
Dr Li Mei
Dr Trudy Milne
Dr Christopher Robertson
Dr Suzan Stacknik
Prof Murray Thomson
A/Prof Geoffrey Tompkins
A/Prof Jonathan Broadbent
A/Prof Nick Chandler
Prof Warwick Duncan
Dr Manikandan Ekambaram
A/Prof Lyndie Foster Page
A/Prof Nick Heng
Dr Benedict Seo
Dr Ajith Polonowita

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DClinDent students

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Rachel Farrar
James Millar
Danielle Hodgkinson
Ghassan Idris
Simon Olliver
Wei Lin
Ana Low
Caleb Lawrence
Divya Ramanan
Fiona Firth
Will Sew Hoy
Austin Kang
Azza Al-Ani
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Coreen Loke
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PhD students

Hisham Yasser
Sabarinath Prasad
Joseph Antoun
Erin Hutchinson
Andrew Quick

Collaborations

University of Otago

Dr Azam Ali (Applied Sciences)
Hamza Bennani (Computer Science)
Dr Claire Cameron (Preventive & Social Medicine)
A/Prof George Dias (Anatomy)
A/Prof Julia Horsfield (Pathology)
A/Prof Barbara Galland (Women's and Children's Health)
Dr Louise Mainvil (Human Nutrition)
A/Prof Tony Merriman (Biochemistry)
A/Prof Michael Paulin (Zoology)
A/Prof Sylvia Sander (Chemistry)
Prof Steven Robertson (Women's and Children's Health)
Center for Bioengineering and Nanomedicine
Genetics Otago
Neuroscience Programme
Otago Zebrafish Facility

National

New Zealand Biomouth Research Group

International

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Dr Iacopo Cioffi (University of Toronto)
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Prof Luigi Gallo (University of Zurich)
A/Prof David Healey (University of Brisbane)
Dr Jialing Li (Nanjing Medical University)
Prof Ambra Michelotti (University of Naples, Federico II)
Prof Sandro Palla (University of Zurich)

Current research

Smart-phone assisted monitoring of jaw muscle activity in freely moving individuals with and without myogenous temporomandibular pain

Investigators: Sabarinath Prasad, Divya Ramanan, Michael Paulin, Richard Cannon, Mauro Farella

Aim: To: 1) collect objective data on masticatory muscle activity during wake-time in the natural environment using a smart-phone assisted wireless electromyographic (EMG) device; and 2) compare the features of masticatory muscle activity between females with myogenous temporomandibular disorder (TMD) and age-matched pain-free controls.



Smart-phone assisted EMG device developed at the University of Otago for continuous monitoring of jaw muscle contractions. The device provides a comprehensive analytical tool to estimate when, how often, how long, and how strongly the jaw muscles contract.

EMG activity was detected unilaterally using a minimally invasive wireless EMG device attached to the skin overlying the masseter muscle and connected to a smart-phone serving as data logger. Study participants performed a series of standardised tasks in a laboratory setting, wearing both the wireless device and reference standard EMG equipment, and then wore the wireless device for at least eight hours while performing their normal routine activities. For Aim #2, EMG activity was collected in females with myogenous TMD and age-matched pain-free controls while performing their normal routine activity over two consecutive days. Contraction episodes were detected at three thresholds: 3, 5 and 10 per cent of maximum voluntary contraction (MVC). The frequency, duration and amplitude of masseter contraction episodes were calculated and compared across groups and conditions using intraclass correlation coefficients (ICC) and mixed model analysis.

The wireless device reliably detected masseter muscle contraction episodes under both laboratory and natural environment conditions. Most masseter contraction episodes during normal routine were of low amplitude (<10% of

MVC) and short duration (<10 seconds). A significant difference in total jaw contraction time (%) was found between groups, with longer contractions in the TMD pain group. No significant association was found between self-reported parafunction and masticatory muscle activity.

Conclusions: Myogenous TMD patients contract the masseter for longer than pain-free controls. Smart-phone assisted monitoring of the jaw muscles represents a promising tool to investigate oral behaviour patterns in orthodontic patients.

Three-dimensional analysis of lip changes in response to simulated maxillary incisor advancement

Investigators: Joanne Au, Li Mei, Florence Bennani, Austin Kang, Mauro Farella

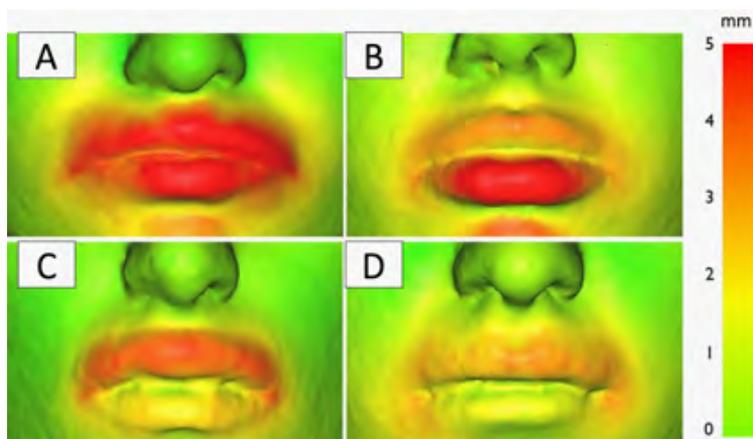
Aim: To assess three-dimensional (3D) lip changes in response to simulated maxillary incisor advancement.

Incremental maxillary incisor advancement was simulated by placing wax of increasing thickness (+2mm, +4mm, +6mm) on the incisors of 20 participants, and the induced lip changes were recorded using 3D stereophotogrammetry. The induced displacement of lip landmarks was quantified using 3D image analysis software. Data was analysed using a repeated-measures analysis of variance (ANOVA).

A large inter-individual variation in lip response to simulated incisor advancement was observed. A significant overall effect on 3D lip changes was found for increasing values of simulated incisor advancement as well as significant differences between anatomical landmarks of the lip. Most points moved outwards and antero-superiorly, except the midpoint and corners of the lip. Greatest movement was observed in the sagittal plane, followed by vertical and transverse planes.

Conclusions: Maxillary incisor advancement significantly affects upper lip change in three planes of space; particularly, the anteroposterior plane, in which the response to simulated advancement appears to be non-linear.

Examples of colour-coded scalar fields from four different female participants (A,B,C,D) with + 6 mm of incisor advancement. Green areas correspond to areas of little to no change (-0.5 mm to 0.5 mm); yellow and red correspond to increasingly positive values of displacement. Note the large interindividual difference in soft tissue response.



Is posterior crossbite a risk factor for temporomandibular joint clicking?

Investigators: Simon Olliver, Jonathan Broadbent, Murray Thomson, Mauro Farella.

Aim: The relationship between dental malocclusion and temporomandibular disorders (TMDs) remains controversial. The aim of this study was to investigate the putative association between posterior cross-bite in adolescence and self-reported temporomandibular joint (TMJ) clicking later in life.

The Dunedin Multidisciplinary Health and Development Study is a longitudinal study of a birth cohort of 1037 children born in Dunedin, New Zealand between April 1972 and March 1973. Health and development data have been collected periodically since then. Posterior cross-bite was clinically assessed when Study members were aged 15 years, and self-reported TMJ clicking (at least occasionally) was assessed at age 38. Cross-tabulations and logistic regression modelling were used to assess whether an association existed between posterior cross-bite and subsequent TMJ clicking.

A total of 726 Study members (70% of the original cohort) were dentally examined at age 15 and also participated at age 38 years. One in three had received orthodontic treatment by the age of 26 years. A total of 94 Study members (13%) had a unilateral or bilateral posterior cross-bite at age 15 years. Among those who had no posterior cross-bite at 15, 33% reported TMJ clicking at least occasionally by age 38 years, while it was 34% among those with a cross-bite at age 15. No association between cross-bite and TMJ clicking was observed, and this held after controlling for their history of orthodontic treatment.

Conclusions: Posterior cross-bite in adolescence is not a risk factor for TMJ clicking by the late thirties.

Ecological momentary assessment of pain in adolescents undergoing orthodontic treatment using a smartphone app

Investigators: Will Sew Hoy, Joseph Antoun, Wei Lin, Nick Chandler, Tony Merriman, Mauro Farella

The purpose of this study was to determine the feasibility of a smartphone application (app) to assess pain levels in real life, and to test their association with gender, age, time in orthodontic treatment, and type of orthodontic adjustment. Eighty-two participants undergoing orthodontic treatment were recruited. A newly developed app was used to assess pain scores at regular intervals in the three days after adjustment of braces. Resting and chewing pain were assessed using sliding digital visual analogue scales. The mean age of the sample was 15.2 ± 1.6 years, the mean time in treatment was 12 ± 8.4 months, and the majority (56.1%) were females.

Resting pain and chewing pain at the teeth rose steadily from baseline, peaked at approximately 20 hours, then decreased gradually over the next two days. Details of the orthodontic adjustments were associated with the total pain experienced at the teeth, with new bond-ups resulting in significantly more pain than routine orthodontic adjustments. Pain levels were not significantly associated with age, gender, or time in treatment.

Conclusions: This smartphone app shows promise in measuring orthodontic pain in the real world, and will aid future research projects which investigate various factors that could influence pain severity.

Funding highlights

Total research funding (external) obtained in the period 2017- 2018 amounted to \$266,311.

Funding highlights 2017-18:

Colgate SJWRI Research Grant. Development of novel bovine derived hydroxyapatite toothpaste for caries prevention (Cathro P, Ratnayake J, Mei L, Guan G, Dias GJ) \$13,423

University of Otago Research Grant. I just want my teeth straightened. (LF Page, JS Antoun, PW Fowler, HC Jack) \$36,000

Ministry of Oral Health Research Fund. Reading between the lines: how do young New Zealanders from lower socio-economic backgrounds feel about not getting their teeth straightened? (LF Page, JS Antoun, HC Jack) \$29,000

Ministry of Oral Health Research Fund. Efficacy of the oral probiotic *Streptococcus salivarius* in managing bio film formation in patients wearing fixed orthodontic appliances (Li Mei, Gareth Benic, Mauro Farella, Nick Heng) \$11,410

CureKids Innovation Seed. A novel approach for monitoring eating behavior in children (Mauro Farella, Ghassan Idris, Barbara Galland, Rachel Taylor, Claire Smith) \$49,458

Other Craniofacial Research projects include:

- Effect of orthodontic extractions on face profile.
- The psychological effect of malocclusion over the life course.
- Development of an ovine model to investigate orthodontic tooth movement
- Impact of psychological and genetic factors on orthodontic pain
- Management of biofilm formation with Air-Flow in patients with fixed orthodontic appliances
- A novel approach for monitoring eating behavior in children
- Relationship between sugar sweetened drinks, tooth wear and dental caries in Māori
- Jaw muscle overload as a possible cause of orofacial pain
- Assessing three-dimensional tooth movements during orthodontic activations using an E-typodont
- The effect of mechanical strain on the unfolded protein response of periodontal ligament cells in a three-dimensional culture
- Predictive factors of orthodontic pain
- Efficacy of a mandibular advancement appliance on Sleep Disordered Breathing in children
- A new approach to engineering 3-dimensional constructs of human bone matrix in a mechanically-active environment
- Genetic and environmental factors associated with hypodontia
- A novel model for exploring the causes and treatments of craniofacial birth defects
- Biofilm management with oral probiotics in orthodontic patients: a triple-blind randomised placebo-controlled trial
- Genetics aspects of the long face
- Growth factor expression in the rat condyle: implications for craniofacial development
- Intra-oral monitoring of oral pH and bruxism

MedTech CoRE Grant-in-Aid. EMG-Guard: a smart-phone assisted wireless EMG device for small superficial muscles. (Mauro Farella, Michael Paulin, Richard Cannon, Maggie-Lee Huckabee) \$25,000.

New Zealand Dental Research Foundation. Development of an ovine model for investigating effects of orthodontic tooth movement (Rachel Farrar, Mauro Farella, Warwick Duncan, Joseph Antoun, Birte Melsen) \$15,000.

New Zealand Dental Research Foundation. Do orthodontic extractions ruin faces? (Danielle Hodgkinson, Mauro Farella, Joseph Antoun, Li Mei, Austin Kang) \$11,654

New Zealand Dental Research Foundation. Effects of different adhesive removal methods on bacterial colonization on in vivo orthodontic bracket model (Ana Low, Joseph Antoun, Li Mei, Geoffrey Tompkins, Mauro Farella) \$11,965.

Key publications

- Chen, L., Liversidge, H., Chen, K., Farella, M., Sassani, S., Patel, D., Brook, A. (2018). Delay in dental development and variations in root morphology are outcomes of the complex adaptive system associated with the numerical variation of hypodontia. *International Journal of Design & Nature & Ecodynamics*, 13(1), 101-106
- Sew Hoy, W., Antoun, J., Lin, W., Chandler, N., Merriman, T., & Farella, M. (2018). Ecological momentary assessment of pain in adolescents undergoing orthodontic treatment using a smartphone app. *Seminars in Orthodontics*. Advance online publication.
- Ma, R., Hwang, K.-C., Murray, C., Thomson, W. M., Farella, M., & Mei, L. (2018). Clinical dental noise and its association with the hearing thresholds of New Zealand dental students and clinical staff. *New Zealand Dental Journal*, 114(2), 73-78.
- Jiang Q, Li J, Mei L, Du J, Levrini L, Abbate GM, Li H. Periodontal health during orthodontic treatment with clear aligners and fixed appliances: a meta-analysis. *Journal of the American Dental Association*. 2018;149(8):712-720.e12.
- Wang S, Lin H, Yang Y, Zhao X, Mei L, Zheng W, Li Y, Zhao Z. Use of autonomous maximal smile to evaluate dental and gingival exposure. *Korean J Orthod*. 2018 May;48(3):182-188.
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- Al-Ani AH, Antoun JS, Stacknik S, Farella M. Management of missing mandibular second premolars: a review. *Aust Orthod J*. 2017 Feb;Spec No:87-98.
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- Antoun JS, Thomson WM, Merriman TR, Farella M. Self-reported oral behaviour habits in hyperdivergent and normodivergent facial types. *J Oral Rehabil*. 2017 Jan;44(1):16-21.
- Meredith, L., Mei, L., Cannon, R. D., & Farella, M. (2017). Interproximal reduction in orthodontics: Why, where, how much to remove? *Australasian Orthodontic Journal*, 33(2), 150-157.
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- Wen J, Liu S, Ye X, Xie X, Li J, Li H, Mei L. Comparative study of cephalometric measurements using three imaging modalities: 2D lateral cephalometric radiography, 2D CBCT-generated cephalogram and 3D CBCT. *Journal of the American Dental Association*. 2017;148:913-921.

Dental Education Research

Programme leader

Dr Lee Adam

Deputy Programme Leader: Dr Susan Moffat

Programme overview

Research in dental education focuses on enhancing theoretical and evidence-based policies and practices in teaching and learning. Researchers in the Dental Education Research Programme typically examine educational experiences in the Faculty and other dental education environments in order to foster a positive impact on education in both the clinical and traditional teaching and learning environments.

We seek to use research to identify strategies and practices that can improve experiences and support for students and educators, both within the University of Otago Faculty of Dentistry, and in other education environments.

KEY PERSONNEL

Dr Lee Adam	Dr Carolina Loch
Dr Susan Moffat	Prof Paul Brunton
Mrs Alison Meldrum	Mrs Hanna Olsen
Prof Alison Rich	Mrs Dorothy Boyd
Dr Lee Smith	Mrs Deanna Beckett
A/Prof Jonathan Broadbent	Dr Arthi Senthikumar
Dr Andrew Tawse-Smith	

Current research

The value of clinical placements in Australasian dental education

Investigators: Lee Adam, Alison Meldrum, Susan Moffat, Lee Smith

This research, funded by the Australasian Council of Dental Schools, is a mixed methods study undertaken in 2018, exploring the educational benefits and logistics of dental and oral health therapy students' clinical placements in Australasia. Academic and administrative staff from Australasian dental schools, as well as staff from clinical host providers, were surveyed and interviewed.

The research found that across Australasia there are a variety of placement models and locations. Clinical placements are deemed by all stakeholders to have a multitude of advantages for students, institutions, and host providers and the communities they serve. However, they involved substantive workloads for both institutions and



Dr Lee Adam presenting dental education research at the IADR General Session in London, July 2018.

providers, and providers reported that hosting students can lead to a decrease in clinical productivity for their organisation.

The research highlighted the need for increased communication between institutions and providers regarding the expectations of students and host organisation clinical supervisors.

Stress and mood states of New Zealand dental students

Investigators: Paul Brunton, Jonathan Broadbent, Lee Adam, Alison Rich, Alison Meldrum

This longitudinal study investigates the perceived stressors and transient mood states of BDS students at the University of Otago Faculty of Dentistry. All BDS students are surveyed twice yearly using the Perceived Stress scale, the Brief Resilience Scale and the Profile of Mood States instruments. Data will be used to gain an understanding of the perceived stressors and psychological functioning (including coping) of undergraduate BDS students, and how stress and functioning varies within and between each class group, between each year of study, and over the course of each year.

Preliminary results suggest the BDS students' stress scores are significantly higher than those of other tertiary students, and their resilience scores are lower than those found in other populations. When the students' mood states are matched against performance, early indicators suggest that there is a positive relationship between students feeling 'on top of things' and higher academic grades.

Comparing the microbiology syllabi between University of Otago and the world's top dental schools

Investigators: Yee En Chen, Wei Theng Chen, Desmond Cheong, Richard Cannon, Geoff Tompkins, Lee Adam

Oral microbiology is a core component of dental education, however, what should be taught? There is a lack of studies comparing the oral microbiology syllabi of the general dental degree among dental schools.

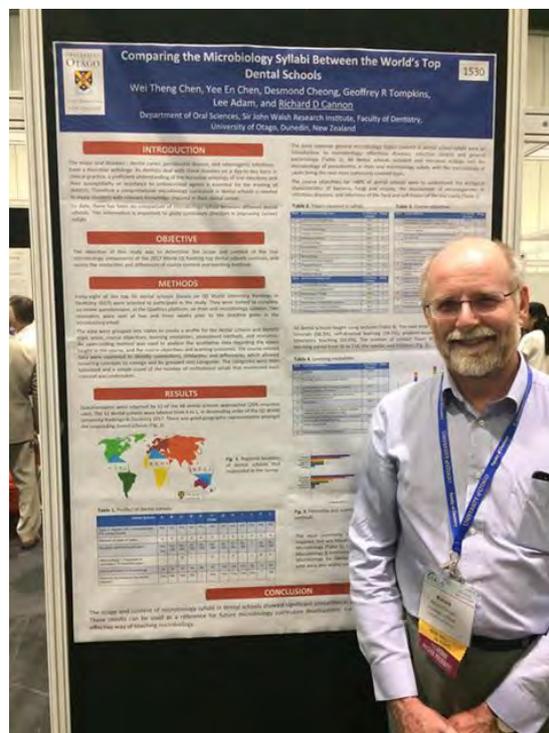
The objective of this study was to determine the scope and content of the oral microbiology components of the 2017 World QS Ranking top dental schools curricula, and assess the similarities and differences of course content and teaching methods.

A questionnaire was sent to 48 of the top 50 dental schools requesting course syllabi for the microbiology component of their dental degree. The syllabi were analysed using an open-coding method to produce a profile of topic areas and course objectives. The similarities and differences between microbiology teaching at the dental schools, including topics taught and course objectives, were determined. Questionnaires were returned by 12 of the dental schools (25%) and 11 provided their microbiology syllabi.

The most common topics taught were: an introduction to microbiology; oral microbial ecology; and the microbiology of periodontitis. The top course objectives were to: demonstrate understanding of the biological characteristics of bacteria, viruses and fungi; describe the involvement of microorganisms in infectious disease; and understand infection of hard and soft tissues of the oral cavity.

Lectures were the most commonly used teaching modality, employed by all of the participating dental schools, while the most commonly used assessment method was multiple-choice questions. One textbook was required or recommended reading for 73% of dental schools.

The scope and content of microbiology syllabi in dental schools showed significant similarities in a wide range of topic areas and course objectives. These results can be used as a reference for future microbiology curriculum development.



Prof Richard Cannon presenting research at the IADR General Session in London, July 2018.

Clinical tutors and their teaching practice

Investigators: Lee Smith, Lee Adam, Alison Meldrum

Although many clinical educators (Dental Clinical Tutors and Professional Practice Fellows) have vast experience in clinical dental practice, many come into tertiary education with no formal teacher training. Clinical expertise is assumed as marking a dental professional as a good clinical educator, but this is not necessarily the case.

Students have reported that self-identifying dental 'experts' are frequently unable to disseminate their knowledge; instead, students rate good clinical educators as those who can define complex concepts, motivate students, maintain rapport, show enthusiasm, and are organised and caring.

Previous research with clinical tutors at the Faculty of Dentistry identified a number of barriers to the retention of tutors, including perceived lack of opportunities for career and pay progression, little support for teaching, few opportunities for undertaking research, and lower pay-rates than if they were employed as a practitioner outside of the University. Approximately two thirds of participants (n=47) said that they thought a formal teaching qualification should be mandatory for this role.

In 2018 we began researching the value that a cohort of clinical educators' placed on formal teaching training,



how they rated their own teaching ability, and how they thought the Faculty of Dentistry could support them with their teaching. Our overarching objective was to investigate challenges the clinical educators experienced in their teaching. The results of this research will inform professional development opportunities provided by the Faculty of Dentistry going forward.

Perceptions of stressors of Bachelor of Oral Health students

Investigators: Hanna Olson, Susan Moffat, Deanna Beckett, Lee Adam, Andrew Tawse-Smith

Despite a recent trend to investigate students' stressors in dentistry learning environments, there is little research on students' stressors in the oral health learning environments. This study aimed to identify self-perceived stressors of Bachelor of Oral Health students to determine if the learning support provided at the Faculty of Dentistry is meeting students' needs.

All Bachelor of Oral Health students (n=135) were invited to complete an online modified version of the Dental Environmental Stress Survey. The survey consisted of 39 questions: 7 collecting demographic information, 1 free comment box, and 31 items related to various potential sources of stress which students were asked to rate on a 5-point Likert-type scale ranging from 'not at all stressful' to 'extremely stressful'. Additionally, the student learning support system was examined. Around half of the group of respondents were first-year students, with participants from second and third years equally distributed. The items 'fear of being unable to catch up if behind' and 'examinations and assessments' scored the highest, indicating that the students perceived these to be their greatest stressors.

Overall, academic requirements were the highest scoring self-perceived stressors for students from all year groups. Stressors related to the clinical environment were highest for second-year students, which is when students start seeing patients. Although there is an existing network of support for students, the study identified several self-perceived stressors over 3 years of Bachelor of Oral Health study that have implications for student support.

Sustainable staff recruitment and retention in Dentistry

Investigators: Paul Brunton, Arthi Senthilkumar, Carolina Loch, Lee Adam

This study was conducted to identify factors that affect retention and recruitment of dental clinical teaching staff at the Faculty of Dentistry. The study has explored issues that influence the clinicians to take up teaching roles and

possible barriers to continue in their current role.

A short questionnaire survey was distributed to current dental clinical teaching staff to understand the retention strategies and barriers. The response rate was almost 96% with equal distribution of female and male clinicians. The majority of participants were European New Zealanders, followed by Asians. Themes identified to improve the retention strategies were the necessity of formal teaching skills, clinical teaching as a career pathway, pay progression, lack of support, and workload.

The study results suggested that the respondents were motivated to give back to their profession through engaging in dental clinical teaching. Clinical teaching staff can be retained by assigning a clear career pathway and encouraging career progression.

Feedback processes in the clinical dental learning environment

Investigators: Lee Adam, Alison Meldrum, Alison Rich

Creating an optimal clinical learning environment poses a challenge to health professions educators. To evaluate and improve the clinical learning environment, it is necessary to understand students' experiences of their environment and the factors they perceive as having an impact on their learning.

The aim of this explorative qualitative study was to examine Faculty of Dentistry students' perceptions of their clinical learning environment to gain insights into how learning outcomes could be enhanced. In 2015, all approximately 600 students at all levels of the Bachelor of Oral Health and Bachelor of Dental Surgery degrees were invited to participate in focus groups. Focus groups facilitated by the faculty education research fellow and another researcher employed for the project were conducted during the second half of the academic year.

Twenty-one students from all levels of the two programs attended one of six confidential focus groups. Three broad themes were evident in the results from all groups: feedback processes, assessments and grading, and tutor interactions. In the focus groups, students expressed dissatisfaction regarding current feedback practices, types of feedback to benefit learning, consistency in the grading system, and impact of different educators' teaching styles on learning.

These results indicated a need for further research and curricular efforts to promote good student-teacher relationships in the clinical learning environment, which are paramount for creating an optimal teaching and learning environment and enhancing student outcomes.

Practicing destination of past Bachelor of Dental Surgery graduates

Investigators: Paul Brunton, Arthi Senthilkumar, Carolina Loch, Lee Adam

In New Zealand (NZ), 11% of university students are international, generating 9.9% of the university sector's income. However, there is little research regarding international students' work intentions beyond graduation. This study investigated whether undergraduate students at the University of Otago Faculty of Dentistry intend to practice in NZ after graduation, and whether international dental students (Bachelor of Dental Surgery, Bachelor of Oral Health and Bachelor of Dental Technology) who graduated between 2001 and 2016 are currently practicing in NZ or overseas.

Almost 64% of current international students indicated their intention to stay in NZ after graduation. Only 22% of graduates since 2001 are currently practising in New Zealand, however this trend is increasing. The number of international graduates registered in NZ increased between 2001 and 2016. More than 70% of current students from Malaysia and China indicated their intention to practice in NZ. All students from Brunei and Oman intended to return to their home country. These findings can be used to prepare current and future graduates for a globalised society and multicultural workforce in NZ.

Funding highlights

2018: ACODS (Australasian Council of Dental Schools) grant: \$50,000. Assessment of the value of clinical placements in Australasian Dental Schools. Lee Adam (principal investigator), Alison Meldrum, Susan Moffat, Claire Gallop

2017: MBIE \$13,700. Otago Participatory Science Platform, Sugar in your diet: kino te pai! Carolina Loch, Richard Cannon, Lyndie Foster Page, Deanna Beckett, Lisa Te Morenga, and Tiahuia Kawe-Small (Te Kura Kaupapa Maori Otepoti).

2017, University of Otago Teaching Development Grant, \$19,982. Counteracting the CSI Effect: Enhancing and Developing Forensic Biology Curriculum Content and Delivery. Angela Clark, Elaine Webster, and Richard Cannon.

Other Dental Education Research projects

- Assessing improvements in academic writing in first year Bachelor of Oral Health students

Investigators: D Beckett, J Oranje, L Adam, S Moffat

- Professionalism for the undergraduate oral health professional

Investigators: R Ahmadi, L Smith, L Adam, A Meldrum, S Moffat.

- Evaluate to improve: Using student evaluations to inform teaching improvements

Investigators: L Adam, C Golding

- Inter-professional collaborative practice initiatives in oral health therapy education across Australasia

Investigators: H Olsen, A Senthilkumar

Student projects

- Learning experiences of 4th year Bachelor of Dental Surgery students in relation to perceived clinical tutor teaching approach

Investigators: P Choo, S Zhang, L Adam, C Loch

- Students' experiences of a compulsory undergraduate research paper

Investigators: R Heran, HW Yeang, D Boyd, L Adam, A Meldrum

- Dental students' perspectives of the long case examination

Investigators: T Paul, L Adam, S Moffat

- Perceptions of special needs dentistry

Investigators: A Ramasamy, L Adam, G Ting, A Rich

- The teaching of posterior composites: a survey of dental schools in Oceania

Investigators: Y Liaw, P Metussin, C Loch, P Brunton

- I am a lefty in a right-handed world: qualitative analysis of clinical learning experiences of left handed undergraduate dental students

Investigators: E Al Lawati, H Al Maskari, S Ma



Prof John Broughton presenting dental education research at the IADR General Session in San Francisco, March 2017.

Key publications

Ebbeling, S., Adam, L., Meldrum, A., Rich, A., McLean, A., & Aitken, W. (2018). Oral health and dental students' perceptions of their clinical learning environment: A focus group study. *Journal of Dental Education*, 82(10), 1036-1042. doi: 10.21815/JDE.018.102

Smith, L., Adam, L., Moffat, S., Meldrum, A., & Ahmadi, R. (2018). How do educators in one New Zealand undergraduate Bachelor of Oral Health course teach and nurture professionalism? *European Journal of Dental Education*, 22(2), e212-e220. doi: 10.1111/eje.12274

The, A. J. M., Adam, L., Meldrum, A., & Brunton, P. (2018). Dental students' and staff perceptions of the impact of learning environment disruption on their learning and teaching experiences. *European Journal of Dental Education*, 22(3), 151-159. doi: 10.1111/eje.12293

Veerasamy, A., Loch, C., Adam, L., Howe, B. J., & Brunton, P. A. (2018). Challenges in clinical teaching investigated: Towards sustainable staff recruitment and retention in dentistry. *European Journal of Dental Education*, 22(4), 234-242. doi: 10.1111/eje.12336

Adam, L., Anderson, V., & Spronken-Smith, R. (2017). 'It's not fair': Policy discourses and students' understandings of plagiarism in a New Zealand university. *Higher Education*, 74(1), 17-32. doi: 10.1007/s10734-016-0025-9

Brunton, P. A., Ghazali, A., Tarif, Z. H., Loch, C., Lynch, C., Wilson, N., Blum, I. R. 2017. Repair vs replacement of direct composite restorations: A survey of teaching and operative techniques in Oceania. *Journal of Dentistry*. Advance online publication. doi: 10.1016/j.jdent.2017.02.010

Smith, L., Adam, L., Moffat, S., Meldrum, A., & Ahmadi, R. (2017). Undergraduate Bachelor of Oral Health student and educators' understandings of professionalism. *New Zealand Dental Journal*, 113(1), 4-10.

Lai, K.-W., & Smith, L. (2018). Socio-demographic factors relating to perception and use of mobile technologies in tertiary teaching. *British Journal of Educational Technology*, 49(3), 492-504. doi: 10.1111/bjet.12544

Lai, K.-W., & Smith, L. (2018). University educators' perceptions of informal learning and the ways in which they foster it. *Innovative Higher Education*. Advance online publication. doi: 10.1007/s10755-018-9434-2

Lai, K.-W., & Smith, L. A. (2017). Tertiary students' understandings and practices of informal learning: A New Zealand case study. *Australasian Journal of Educational Technology*, 33(2), 115-128. doi: 10.14742/ajet.2937

Raphael, S. L., Foster Page, L. A., Hopcraft, M. S., Dennison, P. J., Widmer, R. P., & Wendell Evans, R. (2018). A survey of cariology teaching in Australia and New Zealand. *BMC Medical Education*, 18, 75. doi: 10.1186/s12909-018-1176-4

Olson, H., Beckett, D., Moffat, S., Adam, L., & Tawse-Smith, A. (2018). Self-perceived stressors of Bachelor of Oral Health students and level of support in the oral health learning environment. *Journal of Dental & Craniofacial Research*, 3, (pp. 40). doi: 10.21767/2576-392X-C1-001

Senthilkumar, A., Adam, L., Loch, C., Howe, B. J., & Brunton, P. (2018). Challenges in clinical teaching investigated: Towards sustainable staff recruitment and retention in dentistry. *New Zealand Dental Journal*, 114(4), (pp. 185).

Dental Epidemiology & Public Health

Programme leader

Professor Murray Thomson

Deputy Programme Leader: Associate Professor Jonathan Broadbent

Programme overview

Our work has the two main strands of (1) dental epidemiological research and (2) dental health services research. In our dental epidemiological research, we study the occurrence, determinants and natural history of the common oral conditions. To do this, we employ a number of standard dental epidemiological approaches (most notably the prospective cohort study and the cross-sectional survey) and techniques. Our dental health services research (HSR) work is concerned with how the dental healthcare system works (including dental workforce research), and the extent to which users are benefitting from it. Key activities are measuring oral health outcomes and increasing understanding of how (and why) people use (or do not use) dental services. Our group also plays an important role in the development and epidemiological validation of self-report measures, working in collaboration with a number of overseas researchers.

Current research

Activity 1. Life-course research in oral health (the Dunedin Study)

Description: Prospective observational research into the natural history of oral health and disease in a representative birth cohort now in adulthood

Aim: Unprecedented information on the natural history of oral health and disease

Sources of funding: Health Research Council of New Zealand, National Institutes of Health (USA), Otago Medical Research Foundation

KEY PERSONNEL

Professor Murray Thomson
Professor John Broughton
Assoc Prof Jonathan Broadbent
Dr Lee Smith
Dr Susan Moffat
Assoc Prof Lyndie Foster Page
Ms Dara Shearer

Postgraduate student completions, 2017-18

DClinDent

Poppy Horne
Mohd Nor Hafizi Bin Mohd Ali
Nina Scott
Adlin Suhaimi
William Fogarty
Leonard Chia
Soo-Wee Ong

PhD

Norhasnida Nordin

Master of Health Science

Kay Hine Berryman

Master of Public Health

Deanna Beckett

Master of Community Dentistry

Ellen Johnson
Donna Kennedy Langley



The Dunedin Study Phase 45 team.

Collaborators

National

Dr Moira Smith (University of Otago Wellington)

Professor Ngaire Kerse (University of Auckland)

Raukura O Hauora Tainui

Waikato-Tainui College for Research and Development

Canterbury District Health Board

International

University of Adelaide

University of Melbourne

University of Toronto

McGill University

Osaka University

Universiti Malaya

Duke University

University of Michigan

University of North Carolina

GKT Dental Institute, UK

University of London

Sheffield University

Dundee University

University of Chile

Federal University of Pelotas, Brazil

University of Rio Grande do Sul, Brazil

Outcomes during 2017-18: Work in this area continues to attract international attention and to be published in the top international journals: 9 papers were published, and a number of conference presentations were made. We continued conducting the age-45 assessments, using funds from an HRC project grant. The funded aims of the dental research component for age 45 were to: (1) produce unprecedented information on the natural history of oral health and disease; (2) test hypotheses for genetic and environmental risk factors for chronic dental diseases; (3) identify treatable early-life antecedents of high-rate dental caries and periodontitis in adulthood; (4) quantify ageing of the teeth and dentition, and relate this to early life exposures to environmental factors, along with genetic factors; and (5) quantify the public health significance and financial burden of the cost of treating acute and chronic dental conditions through life.

Activity 2. Other dental epidemiological and clinical research

Description: Dental epidemiological and other studies in NZ and overseas.

Aims: Various – enhancement of the knowledge base for dental epidemiology, dental public health, and clinical practice. A key component of this work is our gerodentological research, which is growing in importance and scope as the dentate older population increases in size. Dr Moira Smith (UOW) and Professor Ngaire Kerse are key collaborators.

Sources of funding: Various, including NZ Ministry of Health, NZ Dental Research Foundation and the Health Research Council of NZ.

Outcomes during 2017-18: 25 papers were published.



Prof Murray Thomson and Dr Lee Smith.

Activity 3. Dental health services research

Description: Dental health services research in NZ, including ongoing, systematic dental workforce research, work on social accountability, barriers to oral health for Pacific adolescents, and access to orthodontic treatment for disadvantaged adolescents.

Aims: Enhancement of the knowledge base for dental public health and clinical practice.

Source(s) of funding: Various, including NZ Dental Research Foundation and the Health Research Council of NZ.

Work in this area uses both quantitative and qualitative approaches, and continues to be diverse and productive.

Outcomes during 2017-18: 33 papers were published (this total includes 1 dental educational research paper by our team which is included here because it did not fit the other categories).

Activity 4. Development of new dental epidemiological, clinical and health services researchers and research capacity

Description: Training of new researchers for NZ and the Asia-Pacific region.

Aim: to build research capacity in our field.

Outcomes during 2017-18: our successful postgraduate completions comprised 1 Doctor of Philosophy, 7 Doctors of Clinical Dentistry, and 3 Masters degrees. We are currently supervising 4 Doctors of Philosophy, 6 Doctors of Clinical Dentistry, and 5 Masters degrees. We also continue to informally mentor colleagues working in the wider health sector, both internationally and in New Zealand.



Prof John Broughton and Dr Mark Lawrence (Bay of Plenty District Health Board) at the IADR General Session in London, July 2018.

Funding highlights

2018. Ministry of Health Oral Health Research fund. Estimating unmet dental need and associated resource utilisation costs, and exploring treatment funding options for dependent older New Zealanders. MB Smith (PI), W Leung, WM Thomson, GS Ting. \$42,649.

2018. Ministry of Health Oral Health Research fund. The barriers to, and facilitators for, maintaining oral health and hygiene among a cohort of 40 dentate older home-based residing people who require additional living support. L Smith (PI), MB Smith, WM Thomson. \$43,630.

2018. NIH (via University of Michigan). Phase II RCT of the effectiveness of silver diamine fluoride in arresting cavitated carious lesions. M Fontana (PI). \$39,474.

2017. NHMRC (Australia). Determinants of inequality in child oral health at school age – a prospective cohort study. Do GL (PI), Golley R, Ha D, Leary S, Manton D, Scott J, Thomson WM, Spencer AJ. AUD \$1,229,852.

2017. HRC Research partnerships for healthcare delivery. Barriers to treating tooth decay in children. With Foster Page LA, Whyman R, Anderson V, Keenan C. \$198,588. (Declined)

Key publications

In total, 66 papers and 2 book chapters were published in the peer-reviewed international scientific literature during the 2017-18 period (this does not include papers which were in press but did not have pagination assigned). In addition, 32 conference presentations were made, including including 4 keynote addresses.

Baker SR, Foster Page LA, Thomson WM, Broomhead T, Bekes K, Benson PE, del Carmen Aguilar-Diaz F, Do LG, Hirsch C, Marshman Z, McGrath C, Mohamed AR, Robinson PG, Traebert J, Turton BJ, Gibson BJ. Structural determinants and children's oral health: A cross-national study. *Journal of Dental Research* 97: 1129-1136 (2018).

Ballantyne PJ, Norris P, Parachuru VP, Thomson WM. Becoming a 'pharmaceutical person': medication use trajectories from age 26 to 38 in a representative birth cohort from Dunedin, New Zealand. *Social Science and Medicine Population Health* 4: 37-44 (2017).

Barazanchi A, Nabhani AL, Chen A, Smith M, Broadbent JM. Oral Health Care Needs Among Former Refugees of the war in Syria. *New Zealand Dental Journal* 114:3, 117-123 (2018).

Beckley AL, Caspi A, Broadbent JM, Harrington H, Houts RM, Poulton R, Ramrakha S, Reuben A, Moffitt TE. Association of childhood blood lead levels with criminal offending. *JAMA Pediatrics* 172: 166-173 (2018).

Cidro J, Maar M, Peressini S, Schroth RJ, Broughton J, Jamieson L, Lawrence HP. Strategies for Meaningful Engagement between Community-Based Health Researchers and First Nations Participants. *Frontiers in Public Health* 2017; 5: 138. (doi: 10.3389/fpubh.2017.00138).

Foster Page LA, Beckett D, Ahmadi R, Schwass DR, Leon de la Barra S, Moffat S, Meldrum A, Thomson WM. Resin infiltration of caries in primary molars in a community setting: 24-month RCT findings. *JDR Clinical & Translational Research* 2: 287-294 (2017).

Foster Page LA, Boyd DH, Fuge K, Stevenson A, Goad K, Sim D, Thomson WM. The effect of bitewing radiography on estimates of dental caries experience among children differs according to their disease experience. *BMC Oral Health* 18: 137 (2018). doi: 10.1186/s12903-018-0596-1.

He S, Thomson WM. An oral epidemiological comparison of Chinese and New Zealand adults in two key age groups. *Community Dentistry and Oral Epidemiology* 46: 154-160 (2018).

Moffat, S. M., Foster Page, L. A., & Thomson, W. M. (2017). New Zealand's School Dental Service over the decades: Its response to social, political, and economic influences, and the effect on oral health inequalities. *Frontiers in Public Health*, 5, 177. doi: 10.3389/fpubh.2017.00177

Moffat, S., Meldrum, A., Aitken, W., & Coates, D. (2017). The delivery of oral health messages by primary health care nurses. *New Zealand Dental Journal* 113(2), 4-9.

Reuben A, Caspi A, Belsky DW, Broadbent JM, Harrington H, Sugden K, Houts RM, Ramrakha S, Poulton R, Moffitt TE. Association of Childhood Blood Lead Levels With Cognitive Function and Socioeconomic Status at Age 38 Years and With IQ Change and Socioeconomic Mobility Between Childhood and Adulthood. *Journal of the American Medical Association* 317:12, 1244-1251 (2017).

Schwendicke F, Foster Page LA, Smith LA, Fontana M, Thomson WM, Baker SR. To fill or not to fill: A qualitative cross-country study on dentists' decisions in managing non-cavitated proximal caries lesions. *Implementation Science* 13: 54 (2018).

Shackleton N, Broadbent JM, Thornley S, Milne BJ, Crengle S, Exeter DJ. Inequalities in dental caries experience among 4-year-old New Zealand children. *Community Dentistry and Oral Epidemiology* 46: 288-296 (2018).

Shearer DM, Thomson WM, Cameron CM, Ramrakha S, Wilson G, Wong TY, Williams MJA, McLean R, Theodore RM, Poulton R. Periodontitis and multiple markers of cardiometabolic risk in the fourth decade: a cohort study. *Community Dentistry and Oral Epidemiology* 46: 615-623 (2018).

Shearer DM, Thomson WM, Mann J, Poulton R. Periodontitis is not associated with metabolic risk during the fourth decade of life. *Journal of Clinical Periodontology* 44: 22-30 (2017).

Smith, L., Adam, L., Moffat, S., Meldrum, A., & Ahmadi, R. (2017). Undergraduate Bachelor of Oral Health student and educators' understandings of professionalism. *New Zealand Dental Journal*, 113(1), 4-10.

Smith, L., Adam, L., Moffat, S., Meldrum, A., & Ahmadi, R. (2018). How do educators in one New Zealand undergraduate Bachelor of Oral Health course teach and nurture professionalism? *European Journal of Dental Education*, 22(2), e212-e220. doi: 10.1111/eje.12274

Thomson WM, Broder HL. Oral-Health-Related Quality of Life in children and adolescents. *Pediatric Clinics of North America* 65: 1073-1084 (2018).

Thomson WM, Smith MB, Ferguson CA, Kerse NM, Peri K, Gribben B. Oral health, cognitive function and dependency among New Zealand nursing home residents. *Gerodontology* 35: 185-191 (2018).

Tiwari T, Jamieson L, Broughton, J, Lawrence HP, Batliner TS, Arantes R, Albino J. Reducing Indigenous Oral Health Inequalities: A Review from 5 Nations. *Journal of Dental Research* 2018; 97: 869-877.

Molecular Microbiology

Programme leader

Associate Professor Brian Monk

Deputy Programme Leader: Associate Professor Geoffrey Tompkins

Programme overview

Molecular Microbiology research within the SJWRI encompasses microbiological investigations applied to a variety of disciplines relevant to Dentistry. These include endodontics, periodontics, implantology, cariology and treatment with antimicrobials, antifungal and antibacterial drug development, drug resistance, structural biology and microbial genomics. Research is primarily conducted in the Molecular Biosciences Laboratory, which in October 2018 relocated to a temporary facility in the ground floor of the Department of Biochemistry Building.

Major funding supporting research within the Programme during 2017-2018 came from the New Zealand Dental Research Foundation, the Ministry of Health Oral Health Research Fund, the New Zealand Health Research Council, the Marsden Fund, the Ministry of Business Innovation and Employment, the Catalyst Fund of the Royal Society of New Zealand, the Maurice and Phyllis Paykel Trust, the Fuller Scholarship, the SJWRI Sir Thomas Kay Sidey Postdoctoral Fellowship, Otago Innovation Ltd, the Otago Medical Research Foundation, KiwiNet, the Lottery Grants Board, the Otago Participatory Science Platform (supported by MBIE Curious Minds).

Current research

Structure-directed discovery of next-generation antifungals

Principal Investigators: Brian Monk, Mikhail Keniya, Rajni Wilson, Alia Sagatova

A paucity of structural information on existing antifungal targets and the emerging problem of antifungal resistance affect both medicine and agriculture. These problems are being addressed by overexpressing in yeast the azole drug target lanosterol 14 α -demethylase, the terbinafine drug target squalene monooxygenase, the echinocandin drug target glucan synthase and drug efflux pumps from the ATP binding cassette and major facilitator superfamilies. These constructs provide proteins for purification and structural resolution by X-ray crystallography plus key tools that enable targeted screens for antifungals and valuable tests of antifungal efficacy.

Since 2014 the group has deposited in the Protein Data Bank over 30 crystal structures of wild type and mutant lanosterol 14 α -demethylase from *Saccharomyces cerevisiae* in complex with a range of azole drugs and agrochemicals, plus the first crystal structures of a full-length lanosterol 14 α -demethylase from fungal pathogens (*Candida glabrata* and *Candida albicans*). This information is being used to design potent chimeric antifungals that combine the best attributes of existing antifungals and has enabled computer-based screens of large compound libraries in efforts to discover novel antifungals. Our research platform has also undertaken research on lanosterol 14 α -demethylase in other important and emerging fungal pathogens including the human pathogens *Aspergillus fumigatus*, *Cryptococcus neoformans* and *Candida parapsilosis* and the plant pathogens *Zymoseptoria tritici* and *Phakopsora pachyrhizi*.

KEY PERSONNEL

Associate Professor Vincent Bennani

Professor Richard Cannon

Dr Peter Cathro

Associate Professor Dawn Coates

Dr Gemma Cotton

Dr Nick Heng

Dr Ann Holmes (retired 2018)

Dr Mikhail Keniya

Dr Erwin Lamping

Dr Hee Ji Lee

Associate Professor Jonathan Leichter (retired 2018)

Professor Karl Lyons

Dr Li Mei

Dr Trudy Milne

Associate Professor Brian Monk

Dr Alia Sagatova

Dr Don Schwass

Associate Professor Geoffrey Tompkins

Dr Hamish Upritchard

Dr Rajni Wilson

Dr Mathew Woods

Postgraduate Students

Dina Abdelmoneim (PhD)

Zhen Dong (PhD)

Asrar Elahi (PhD)

Parham Hosseini (PhD)

Chitra Krishnan (PhD)

Golnoush Madani (PhD)

Yasmeem Ruma (PhD)

Syarida Safii (PhD, graduated 2018)

Amira Salem (PhD)

Shaikha Al Samahi (PhD)

Deepak Cheilappa (DClintDent)

James Millar (DClintDent)

Nurul Thiyahuddin (DClintDent)

Oswaldo Gonzales (MDS)

Joshua Donn (MS)

Summer and honours students

Lauren Allen (2017-18)

Bomi Aum (2018-19)

Danyon Graham (2017)

Anne Jude (2017-18, 2018-19)

Manish Kumar (2016-17, 17-18)

Hetal Shukla (2017-18)

Visiting researchers

Jasper James (2018-2019),
Universiti Kebangsaan
Malaysia, Kuala Lumpur

Associate Professor Michaela
Lackner (2018), Medical
University of Innsbruck, Austria

Dr Khoon Lim, CReaTE group,
Centre for Bioengineering and
Nanomedicine, UO Christchurch

Intramural collaborators

Dr Mihnea Bostina,
Department of Microbiology

Professor Kurt Krause,
Department of Biochemistry

Associate Professor Joel
Tyndall, School of Pharmacy

Dr Mihnea Bostina,
Department of Microbiology

Extramural collaborators

Associate Professor Marina
Bakri, University of Malaya

Dr Ariya Chindamporn,
Chulalongkorn University

Professor Gary Dunny,
University of Minnesota

Dr Edmund Fleischer,
MicroCombiChem, Germany

Associate Professor Maggie-Lee
Huckabee, Uni of Canterbury

Dr Anette Klinger,
MicroCombiChem, Germany

Professor Susumu Kajiwara,
Tokyo Institute of Technology

Professor Amarila Malik,
Universitas Indonesia

Associate Professor Alok Mitra,
University of Auckland

Dr David Musson, University of
Auckland

Dr Kyoko Niimi, Tokyo Institute
of Technology

Dr Masakazu Niimi, Tokyo
Institute of Technology

Professor David Perlin, Rutgers
University

Professor Rajendra Prasad,
Jawaharlal Nehru University

Associate Professor Jacinta
Santhanam, Universiti
Kebangsaan Malaysia

Dr Jan Schmid, Massey
University, Palmerston North

Professor Robert Stroud, UCSF

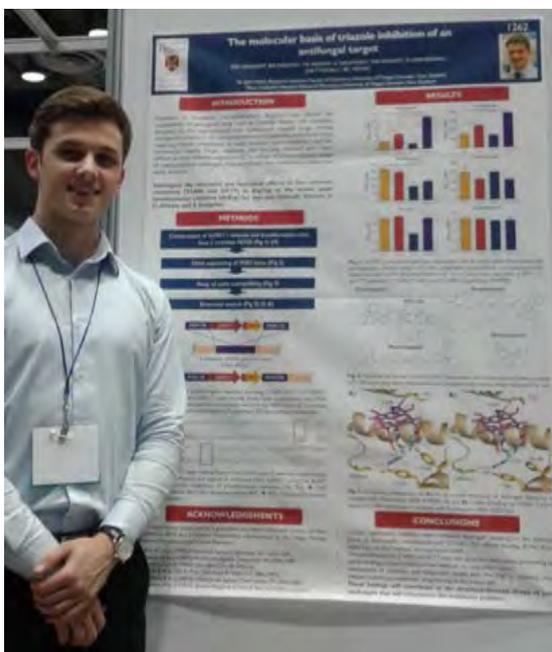
Dr Thomas Tomasiak,
University of Arizona



Visiting researcher Associate Professor Michaela Lackner and PhD students Yasmeen Ruma and Parham Hosseini discuss phenotypes obtained with recombinant yeast.

The group published 5 papers and a book chapter in 2017-2018. Our primary funding is a Health Research Council of New Zealand grant (2016-2019) entitled "Structure-directed discovery of next-generation antifungals", which built on a previous Marden Fund grant (2010-2015) and a Health Research Council of New Zealand grant (2013-2016). The Sir John Walsh Research Institute has supported the research of Thomas Kay Sidey Postdoctoral Fellow Alia Sagatova on squalene monooxygenase. This resulted in the expression and purification of this important antifungal target from yeast. The award of a Catalyst Fund grant supports collaboration with Associate Professor Michaela Lackner of the Medical University of Innsbruck (pictured above with PhD students Yasmeen Ruma and Parham Hosseini). This research is providing phenotypic and structure-based insight into the intrinsic azole resistance associated with the ancient mucormycete family of fungal pathogens.

Research collaborations have involved Associate Professor Joel Tyndall in the University of Otago School of Pharmacy, the laboratory of Professor Robert Stroud at UCSF (San Francisco), the combinatorial chemistry company MicroCombiChem (Wiesbaden, Germany) and Bayer AG Crop Protection Division (Monheim, Germany and Lyon, France).



BDS (Hons) student Danyon Graham presenting his summer student research at the IADR General Session in Seoul, June 2016.



Above: Assoc Prof Brian Monk in the new temporary home for the Molecular Biosciences Laboratory in the Department of Biochemistry.

Fungal colonisation and drug-resistance

Principal investigators: Richard Cannon, Li Mei, Ann Holmes, Hee Ji Lee and Erwin Lamping

The increased incidence of infections caused by drug resistant microorganisms is a major global health concern. While the multidrug resistance of bacteria is most prominent, drug resistance of fungi is also of great concern. The main cause of high-level azole drug resistance in the most common oral fungal pathogens, *Candida albicans* and other non-albicans *Candida* species, is the over-expression of ATP-binding cassette (ABC) transporters that protect cells from azole antifungals. We have used our patented, and further optimised, *Saccharomyces cerevisiae* system for heterologously expressing membrane proteins to study *C. albicans* efflux pump Cdr1. In a project supported by the Marsden Fund, site-directed mutagenesis has been used to investigate the role of amino acids, particularly cysteines, in pump function. We have also used the expression system to study ABC efflux pumps from other important fungal species such as *Candida krusei*, *Candida utilis*, *Penicillium marneffeii*, and the *Fusarium solani* species complex. Other projects have i) identified the mutations increased ~100-fold expression of the major human multidrug efflux pump ABCB1 in our *S. cerevisiae* host and sequenced its entire genome; ii) created a functional, but cysteine-less, version of *C. albicans* Cdr1 for its structural characterization; and iii) studied the possible homo-dimerization of Cdr1 in live yeast cells.

Before organisms can cause oral infections, they must first colonise the oral cavity. Little is known about the range of fungal species and diversity of *C. albicans* strains that colonise people's mouths. We have used rDNA sequencing and multilocus sequence typing (MLST) to identify and investigate fungi colonising people with dentures, oral cancer and older people. Surface roughness of oral surfaces can facilitate oral colonization. We have investigated how interproximal reduction of teeth affects surface roughness and microbial adherence. Our group published 6 papers and 2 book chapters in 2017-2018. Our research has involved collaborations with Associate Professor Alok Mitra (University of Auckland), Dr Jan Schmid (Massey University, Palmerston North), Professors Lutz Schmitt and Holger Gohlke (Heinrich Heine University Düsseldorf, Germany), and recently with Associate Professor Jacinta Santhanam (Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia) and Professor Stefan Raunser (Max Planck Institute for Molecular Physiology, Dortmund, Germany).

Oral bacteriology

Principal investigators: Geoffrey Tompkins, Peter Cathro

Bacteria are involved in various diseases affecting the teeth and gingival tissues. Current projects in this group include: (i) development of new antimicrobials directed at the extremely alkaline-tolerant bacteria that cause root canal treatments to fail; (ii) evaluation of lasers to remove biofilms from dental implants; (iii) the involvement of dental plaque bacteria in the development of aspiration

pneumonia in stroke patients; (v) the effect of various antimicrobials, including chlorhexidine, and silver-based antimicrobials affect oral microbial ecology.

Developing novel antimicrobial agents for oral applications

Principal investigators: Dawn Coates and Gemma Cotton

Antibiotic resistance has become an increasing problem in clinical medicine. This team undertakes research on the development of novel antimicrobials for oral applications and as an adjunct to bone grafting materials. Research includes both chemically synthesised compounds and those derived from New Zealand native plants. Antimicrobial action, formulation, release profiles, molecular mechanisms of action, along with in vitro and in vivo trials on efficacy and compatibility are all conducted.

Microbial profiling and bacteria genome sequencing using next-generation DNA sequencing technology

Principal investigator: Nick Heng

The oral cavity of each human and animal harbours its own distinctive community of microbes, termed the "oral microbiota". The human oral microbiota alone is estimated to comprise over 700 species of microbes. Many species have long been associated with disease such as *Streptococcus mutans* (dental caries) and *Porphyromonas gingivalis* (periodontal disease). Bacterial profiling of oral samples from healthy or diseased participants using next-generation DNA sequencing technology have helped identify some species that may either contribute to disease progression or are associated with good oral health. This research group is also interested in revealing the genomic secrets of cultured species such as the antimicrobial-producing *Streptococcus salivarius* (from humans) and new oral streptococcal species isolated from other animals.

Development of tools to monitor probiotic bacteria using real-time quantitative PCR

Principal investigator: Trudy Milne and Nick Heng

Probiotic species are those that, when colonising humans or animals, are believed to confer beneficial effects on their hosts. Oral probiotics have been developed and are commercially-available to combat/prevent oral pathogens such as *Streptococcus mutans* (dental caries) and *Porphyromonas gingivalis* (periodontal disease). This research team is focused on developing real-time PCR probe sets to specifically detect particular probiotic species. These molecular tools would be useful in monitoring probiotic strains colonising their hosts and, in combination with next-generation DNA sequencing,

determine if they exert any influence on the oral microbiota.

Microbial biofilms

Principal investigators: Vincent Bennani and Li Mei

Most microorganisms live within biofilms and in the mouth these biofilms can cause diseases such as dental caries, periodontitis and peri-implantitis. We are interested in how biofilms form on oral surfaces including denture acrylic, implant titanium, and orthodontic appliances – and measuring how effective methods are for removing these biofilms. We have also investigated the use of *Streptococcal salivarius* strains as probiotics to inhibit the growth of oral pathogens and improve oral health in orthodontic patients.

Oral immunology

Principal investigator: Trudy Milne

Furthering our understanding in the area of immunopathogenesis of periodontal disease and the relationship between periodontal and systemic diseases will benefit clinicians. A study of periodontopathogens associated with periodontal disease and their ability to alter gene expression in various oral mucosal diseases, particularly oral lichen planus and squamous cell carcinoma is ongoing. We are also interested in the effect bacteria and Type 2 diabetes has on dental pulp vitality and healing. The group has published five papers in 2017-2018. Primary funding has been from the New Zealand Dental Research Foundation.

Funding highlights

Tools for drug discovery from an ancient fungal family. Catalyst Seeding Fund of the Royal Society of New Zealand. B.C. Monk and M. Lackner. \$80,000.

A pipetting robot. New Zealand Dental Research Foundation. H.J. Lee, R.D. Cannon and B.C. Monk. \$15,000.

Engineering yeast as an ideal expression host for human P-glycoprotein (ABC1). Otago Medical Research Foundation. E. Lamping and R.D. Cannon. \$15,000.

Drug resistance in the emerging fungal pathogen *Candida auris*. Maurice & Phyllis Paykel Trust. R.D. Cannon and E. Lamping. \$10,000.

Type2 diabetes – How do human pulp cells respond to glucose and lipopolysaccharides? New Zealand Dental Research Foundation. Lara Friedlander, Shaikha Al Samahi, Trudy Milne, Haizal Hussaini, Alison Rich. \$14,890.

Expression of vascular endothelial growth factor and associated pathways in oral squamous cell carcinoma. (2018) New Zealand Dental Dental Research Foundation. Haizal Hussaini, Harsha De Silva, Sajith Edirisinghe, Trudy Milne, Alison Rich. \$14,496.

Key publications

Monk, B.C., Keniya, M.V., Sabherwal, M., Wilson R.K., Graham, D.O., Hassan, H.F., Chen, D., Tyndall, J.D.A. (2018) Azole Resistance Reduces Susceptibility to the Tetrazole Antifungal VT-1161. *Antimicrobial Agents & Chemotherapy* 63(1). pii: e02114-18. doi: 10.1128/AAC.02114-18.

Our research platform provided key insights into azole resistance to a new investigation antifungal drug in clinical trials.

Keniya, M.V., Sabherwal, M., Wilson, R.K., Woods, M.A., Sagatova, A.A., Tyndall, J.D.A., Monk, B.C. (2018) Crystal Structures of Full-Length Lanosterol 14 α -Demethylases of Prominent Fungal Pathogens *Candida albicans* and *Candida glabrata* Provide Tools for Antifungal Discovery. *Antimicrobial Agents & Chemotherapy* 62(11). pii: e01134-18. doi: 10.1128/AAC.01134-18.

The first crystal structures of the full-length lanosterol 14 α -demethylases obtained from fungal pathogens.

Keniya, M.V., Ruma, Y.N., Tyndall, J.D.A., Monk, B.C. (2018) Heterologous Expression of Full-Length Lanosterol 14 α -Demethylases of Prominent Fungal Pathogens *Candida albicans* and *Candida glabrata* Provides Tools for Antifungal Discovery. *Antimicrobial Agents & Chemotherapy* 62(11). pii: e01131-18. doi: 10.1128/AAC.01131-18.

The development of an expression system allowing the production and phenotypic analysis of lanosterol 14 α -demethylases from two important fungal pathogens.

Caramalho, R., Tyndall, J.D.A., Monk, B.C., Larentis, T., Lass-Flörl, C., Lackner, M. (2017) Intrinsic short-tailed azole resistance in mucormycetes is due to an evolutionary conserved aminoacid substitution of the lanosterol 14 α -demethylase. *Scientific Reports* 7(1):15898. doi: 10.1038/s41598-017-16123-9.

The use of phenotypic information and structures obtained by homology modelling to understanding the intrinsic azole resistance of mucormycete pathogens.

Tanabe K., Bonus M., Tomiyama S., Miyoshi K., Nagi M., Niimi K., Chindamporn A., Gohlke H., Schmitt L., Cannon R.D., Niimi M., Lamping E. (2018) FK506 resistance of *Saccharomyces cerevisiae* Pdr5 and *Candida albicans* Cdr1 involves mutations in the transmembrane domains and extracellular loops. *Antimicrobial Agents and Chemotherapy* 63(1): e01146-18.

How the immunosuppressor FK506 inhibits fungal multidrug efflux pumps and how they become insensitive to FK506-inhibition.

Lamping, E., Zhu, J., Niimi, M. and Cannon, R.D. 2017. Role of ectopic gene conversion in the evolution of a *Candida krusei* pleiotropic drug resistance transporter family. *Genetics* 205(4): 1619-39.

Research highlight in the Genetics Society of America Genes to Genomes blog. This article describes how an entire multidrug efflux pump family of the fungal pathogen Candida krusei evolved, over 100s of millions of years, to combat antifungal attack.

Lamping, E., Madani, G., Lee, H.J., Niimi, M. and Cannon, R.D. 2017. Structure-function analyses of multidrug transporters. In *Candida albicans: Cellular and Molecular Biology*, Chapter 18: 379-406. 2nd Ed, R. Prasad. Springer International, ISBN 978-3-319-50409-4, doi: 10.1007/978-3-319-50409-4_18.

Invited book chapter summarizing our current understanding of the two major efflux pump super-families, MFS and ABC transporters, in the major human fungal pathogen, Candida albicans.

Cotton, G. C., Lagesse, N. R., Parke, L., & Meledandri, C. J. (2018). Antibacterial nanoparticles. In S. Hashmi, E. Bayraktar, G. Batalha, D. Brabazon, M. Buggy, I. A. Choudhury, ... C. Zavaglia (Eds.), Reference module in materials science and materials engineering. Elsevier. doi: 10.1016/B978-0-12-803581-8.10409-6.

Presentation of the synthetic methods, mechanism of action, and applications of inorganic nanoparticles as inherent antimicrobial agents.

Smith, M. M., Duncan, W. J., & Coates, D. E. (2018). Attributes of Bio-Oss® and Moa-Bone® graft materials in a pilot study using the sheep maxillary sinus model. *Journal of Periodontal Research*, 53(1), 80-90. doi: 10.1111/jre.12490.

Efficacy of regenerative bone scaffolds in an in vivo system, used in the development of the Silverbone project.

Cotton, G.C., Schwass, D.R., Duncan, W.J., Meledandri, C.J. Patent WO2017061878A1. Antimicrobial containing silver gel.

Cotton, G.C., Schwass, D.R., Meledandri, C.J. WO2018217104A1. Patent Glass ionomer cement containing silver nanoparticles.

Benn, A., Heng, N., Broadbent, J.M., Thomson, W.M. (2018) Studying the human oral microbiome: challenges and the evolution of solutions. *Australian Dental Journal* 63(1), 14-24. doi: 10.1111/adj.12565.

Grazia, S.E., Sumayah, S., Haiti, F.S., Sahlan, M., Heng, N.C.K., Malik A. (2017) Bacteriocin-like inhibitory substance (BLIS) activity of *Streptococcus macedonicus* MBF10-2 and its synergistic action in combination with antibiotics. *Asian Pacific Journal of Tropical Medicine* 10(12), 1140-1145. doi: 10.1016/j.apjtm.2017.11.001.

Heng, N.C.K., Yeh, C.-W., Malik, A. (2017) Draft genome sequence of *Weissella confusa* MBF8-1, a glucanucrase- and bacteriocin-producing strain isolated from a homemade soy product. *Genome Announcements* 5(4), pii: e01497-16. doi: 10.1128/genomeA.01497-16.

Hidayat, M.F.H., Milne, T., Cullinan, M.P., Seymour, G.J. (2017) Feasibility of the Salivary transcriptome as a novel biomarker in determining disease susceptibility. *Journal of Periodontal Research*. DOI:10.1111/jre.12522. *Journal of Periodontal Research* 49 (6) 817-826.

Al-Dujaili, M., Milne, T., Cannon, R.D., Farella M. (2018) Postnatal expression of chondrogenic and osteogenic regulatory factor mRNA in the rat condylar cartilage. *Archives of Oral Biology* 93, 126-132.

Parachuru V., Coates, D. Rich A., Milne T., Seymour G. (2018) FoxP3+ regulatory T-cells may play a more prominent role than IL17 in chronic inflammatory periodontal disease. *Journal of Periodontal Research*. DOI:10.1111/jre.12552

Javadi, L.R., Parachuru, V.P.B., Milne, T., Seymour, G.J., Rich, A.M. (2018) Expression of IL33 and IL35 in oral lichen planus. *Archives of Dermatological Research*. 310(5):431-441. doi: 10.1007/s00403-018-1829-5.

Oral Molecular & Immunopathology

Programme leader

Professor Alison Rich

Deputy Programme Leader: Dr Lara Friedlander

Programme overview

Current information about cellular and molecular mechanisms involved in the pathogenesis of chronic oral diseases and in development and healing allows advancement of diagnostic and treatment modalities. Our group uses a range of cellular, molecular, immunological and pathological tools including cell culture, genomic and focused micro-arrays, real time PCR, laser microdissection and immunohistochemistry to investigate a range of dental and oral mucosal conditions. Of major interest is regulation of the microenvironment in oral squamous cell carcinoma (OSCC) with respect to local and nodal immune regulation, influences on local invasion, angiogenesis and the reaction to endoplasmic stress. Exosomes, membrane bound nanovesicles released by cells into their extracellular environment, contain potential biomarkers of OSCC. Salivary exosomes are easily accessible and we are investigating their extraction and identification. The interest in angiogenesis extends to pulpal tissues in terms of continued root development following pulp injury and the changes in angiogenesis in the pulp in people with diabetes.

Current research

Activity 1. Angiogenesis

Angiogenesis and pulp biology

The microvessel density (MVD) and spatial distribution of endothelial cells and angiogenic activity in immature and mature permanent teeth have been investigated using immunohistochemistry (IHC). Immature teeth were found to have a greater MVD and VEGF/VEGFR2 expression than mature teeth. The increased expression of these markers in the coronal region of both tooth types is important for pulp repair. Non-endothelial cells appear to have a functional role in contributing to angiogenesis.

KEY PERSONNEL

Staff

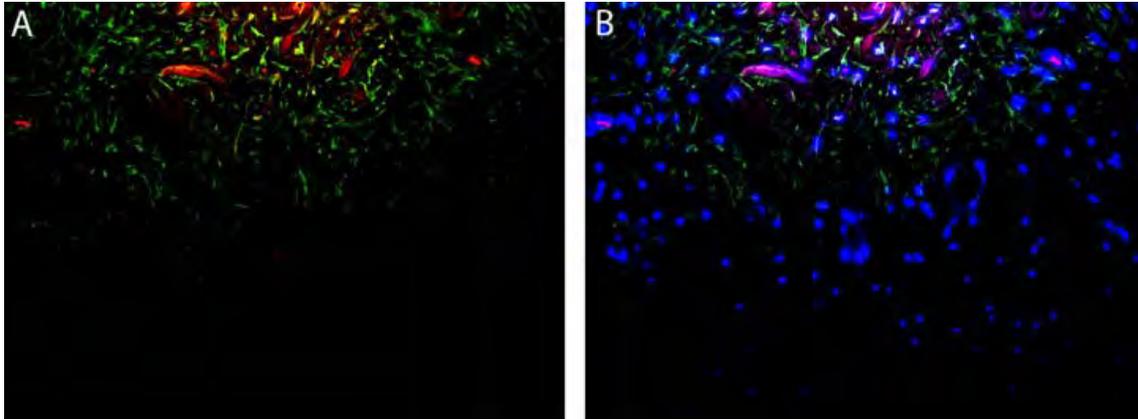
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Members of the Oral Molecular and Immunopathology Programme (2019) with Dr Alexandra Tickle, Commercialisation Manager at Otago Innovation Ltd.



Double Immunofluorescence with vimentin and RAGE (receptor for advanced glycation end products) in the cell rich zone of the coronal pulp showing expression on fibroblasts which are positive for vimentin. Elsewhere in the body, RAGE leads to pro-inflammatory gene activation and is elevated in diabetes. This is part of the PhD project of Shaikha Al Samahi.

Effects of diabetes on angiogenesis in dental and oral tissues

Type 2 diabetes (T2D) is related to inflammatory responses and involves changes in markers that promote inflammation and those that suppress it. The first part of this study was to examine the expression and distribution of advanced glycation end products (AGE), the receptor (RAGE), inflammatory markers and immune cells using IHC in the pulps of normal uninflamed teeth in patients with T2D and normal controls.

The key learning points to date are as follows:

- T2D influences the morphology of the normal dental pulp with increased collagen deposition and reduced vascularity.
- T2D alters the immune response in the pulp which may impair healing
- T2D increased the expression of AGE, RAGE and the inflammatory markers in the pulp; these changes have been observed in other body sites.
- The general medical status of patients should be considered when making clinical decisions on the management of deep caries and vital pulp therapy.

This study will be broadened to investigate these markers in inflamed pulps. In addition, pulp tissue from extracted teeth will be used to grow primary cultures and the effect of different glucose conditions on fibroblast cell proliferation, migration following wounding, and the expression of genes associated with inflammation and healing will be examined.

Angiogenesis and oral squamous cell carcinoma

a) in primary OSCC

This research has shown an upregulation of VEGF, the main angiogenesis promoter in OSCC. In addition it has shown that angiogenic factors were expressed on epithelial cells as well as endothelial cells in OSCC. The findings offer an insight into upregulation of pro-angiogenic genes in oral cancer. In the future, anti-angiogenic therapies in OSCC could prove to be useful as an adjunct to conventional surgical and chemotherapeutic treatments.

International collaborations

Oral Cancer Research and Coordinating Centre (OCRCC), University of Malaya and MAHSA University, Malaysia
www.malaysiaoralcancer.org

Immune modulation in oral cancer, exosomes in oral cancer

Dr J-K Jung and colleagues, Kyungpook National University, Korea

Lymphangiogenesis in oral lichen planus

Dr M Weerasekera and colleagues, University of Sri Jayewardenepura, Sri Lanka

Joint projects investigating the role of Candida in oral carcinogenesis and vascular endothelial growth factor (VEGF) in oral cancer

b) in lymph nodes with metastases from OSCC

Two groups of formalin-fixed paraffin-embedded (FFPE) blocks were accessioned from the OCRCC, Malaysia; Group A comprised cervical lymph nodes with histologically confirmed metastatic deposits from primary OSCC (n=17) and Group B were cervical lymph nodes from patients with primary OSCC without metastatic deposits, (n=17). Immunohistochemistry showed significantly greater VEGF-C (marker associated with lymphangiogenesis) expression in Group A compared with Group B (p=0.0002). Significant positive correlation was found between VEGFC and TNM stage (p=0.004).

Lymphangiogenesis and oral squamous cell carcinoma

Lymphangiogenesis, the formation of new lymphatic vessels, is an essential process in normal growth and development and wound healing. The aim of this study was to investigate the differences, if any, in the expression profile of lymphatic markers and lymph vessel density (LVD) in OSCC in relation to non-specifically inflamed connective tissue (ICT) and normal oral mucosa (NOM) using IHC. The results established that the OSCC tumour microenvironment possessed significantly more lymphatic vessels expressing the lymphatic markers D2-40 and Prox-1 than the control groups. There was also higher expression of LYVE-1+ s in OSCC (compared with the ICT control tissue group). This increase in LVD may play a role in facilitating lymphatic invasion and later metastases. These molecular entities may serve as potential anti-oral cancer therapeutic targets or as potential prognostic markers.

Lymphangiogenesis in an immune-mediated lesion-oral lichen planus

Oral lichen planus (OLP) is a chronic inflammatory immune-modulated oral mucosal disease. As well as epithelial damage there is evidence that the local connective tissue environment is important in the evolution of OLP through the changes induced by chronic inflammation. Inflammatory cells secrete numerous cytokines and growth factors that alter the local fibrous tissue, blood vessels and possibly lymphatics. This study will determine the possible role of lymphangiogenesis in the pathogenesis of OLP by comparing the expression of lymphangiogenic markers in OLP groups with non-specifically inflamed oral mucosa. Clarification of the role of lymphangiogenesis in OLP may provide novel understanding on pathophysiology of OLP. Furthermore it may enhance understanding of the initial alterations towards malignant transformation of OLP, possibly leading the development of diagnostic markers and preventive drugs against malignant transformation of OLP by the modulation of lymphangiogenesis.

Activity 2. Endoplasmic reticulum stress and the unfolded protein response

• In a neoplastic model-oral squamous cell carcinoma

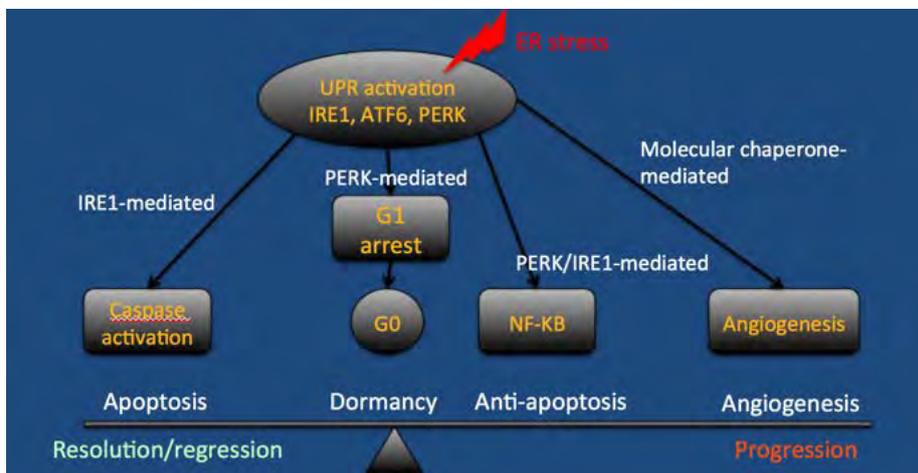
In this study we are investigating cellular stress pathways known as the unfolded protein response (UPR). These pathways are activated when the endoplasmic reticulum (ER), the protein-producing factory within the cell, is stressed. ER stress modulates UPR pathways, thus partially determining the cellular responses to disease. To investigate UPR in OSCC cell lines derived from normal, dysplastic and malignant oral keratinocytes were subjected to tunicamycin-induced ER stress of varying intensity and chronicity. OSCC cells maintained viability in the presence of ER stress at a significantly greater level compared to normal oral keratinocytes. Furthermore, caspase-3/7 activity and DNA fragmentation, hallmarks of cell death, were suppressed in OSCC. It was also discovered that UPR-induced apoptosis-related factors, most notably DDIT3, were significantly up-regulated in OSCC. Also, the master regulator of lipid metabolism, SREBP1, and CREB3L3, an ER-resident transcription factor closely related to ATF6, which plays an important role in linking ER stress with immune-inflammatory responses, were significantly up-regulated in OSCC. The identified factors should be further studied and validated *ex vivo* and, eventually, *in vivo*, in view of their potential diagnostic and prognostic role in improving the diagnosis, treatment and management of oral cancer.

• In relation to signalling pathways-STAT3

The molecule STAT3 is thought to lie at the centre of the mechanisms that affect cancer initiation, progression, and spread. Our objective in this project is to investigate the differential regulation of STAT3 pathway genes and proteins in oral cancer cell lines under induced cellular stress. This model will help us better understand the role of STAT3 pathways, and how cellular stresses in cancer modulate this pathway. The gene and protein regulation patterns showed that ER stress plays a role in immune-modulation in the tumour microenvironment in OSCC by up-regulating tumour-promoting cytokines.

• In relation to cell deformation

Orthodontic tooth movement occurs as teeth move through the surrounding bone following the application of appropriate force. This force results in mechanical loading, with remodelling of the bone and the connective tissue cells and fibres of the periodontal ligament (PDL). We intend to identify and profile the UPR genes expressed by PDL cells that are subjected to mechanical strain in order to examine ER stress markers and apoptosis. PDL cells have been obtained and cultured from premolar teeth that were removed for orthodontic reasons and



Outline of targeted UPR response in cancer which may promote or impede lesional progression. This was prepared by Benedict Seo as part of his PhD project.

will be used to assess the role of ER stress, the UPR, and apoptosis in mechanically strained PDL cells. This has clinical applications in the prevention of root resorption in association with acceleration of tooth movement.

Activity 3. Regulation of immune responses

- *In oral squamous cell carcinoma-regulatory T cells and various cytokines*

OSCC develops in an immune cell-rich environment, where inflammatory cells in the tumour microenvironment establish an anti-tumour response by secreting pro-inflammatory cytokines. At the same time the cancer cells may induce various mechanisms suppressing the anti-tumour response such as regulating a network of suppressive cytokines and the recruitment of suppressive Tregs. These escape mechanisms are seen at the local tumour site and similar mechanisms may also occur in regional lymph nodes (LN). In this project it was postulated that the escape of malignant oral keratinocytes from the primary site and their metastasis to regional lymph nodes is orchestrated by Tregs and their associated immune repertoire. Gene analysis studies demonstrated active regulation of T cell anergy and tolerance genes in primary OSCC and in metastatic lymph nodes. The immune suppression mechanisms were similar in lymph nodes with and without extracapsular (ECS) spread, though the suppression mechanism was stronger in lymph nodes with ECS.

- *In oral lichen planus*

The aim of these studies was to compare the numbers of cells expressing FoxP3 or IL-17 in OLP with non-specifically inflamed oral mucosa and to determine which cell types expressed FoxP3 and/or IL-17 and their distribution, using IHC and quantitative real-time reverse transcriptase

polymerase chain reaction (qPCR). The IHC results showed that the balance between Tregs and IL-17+ cells was altered in OLP, thus supporting the proposition that disturbance in local immune regulation is important in the pathogenesis of OLP. The observation that the IL-17+ cells were mast cells has not previously been reported in OLP and again raises questions about the role of mast cells in this condition. The gene expression experiments revealed a significantly higher expression of FoxP3 in OLP when compared to the controls. IL17 gene expression was not different between the groups. These findings suggest FoxP3+ Tregs have a more prominent role in the pathogenesis of OLP when compared to IL17+ cells.

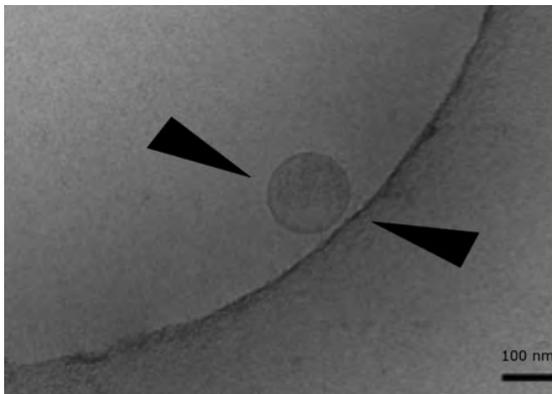
- *In relation to LOX family proteins and odontogenic tumours*

The lysyl oxidase family is a group of copper dependant enzymes comprising lysyl oxidase (LOX) and four enzymes known as lysyl oxidase-like (LOXL)1-4. The primary function of these enzymes is to crosslink collagens and elastin in the extracellular matrix thus stabilizing the matrix. In our study the LOX family proteins and genes showed differential patterns of expression in each odontogenic lesion examined. Significant reduction of LOXL3 was observed in ameloblastoma at both protein and gene levels. LOXL4 protein was overexpressed in the epithelium, but underexpressed in the connective tissue of ameloblastoma and odontogenic keratocyst. The examination of LOX family genes and proteins, in representative odontogenic tumours, will help deepen our understanding of the pathogenesis of these lesions and potentially lead to better patient management.

Activity 4. Exosomes in oral cancer

- *In squamous cell carcinoma*

In the first part of this study we developed methodology to extract and identify exosomes from oral cancer and normal oral keratinocyte cell lines. To extract exosomes from OSCC cells grown in culture ultracentrifugation and an exosome isolation kit (Exoquick TC plus) were used. The extracted vesicles were characterised with a Zetasizer which uses dynamic light scattering to determine the size of particles for the size range 0.6 nm to 6 µm, in addition to using Transmission electron microscopy. Having extracted an adequate number of vesicles and confirmed they were exosomes, we were then able to extract RNA from them. Having completed this baseline cell culture work and refined the techniques to be used going forward, we are now moving on to study exosomes in saliva and blood samples from patients with OSCC and normal controls using samples sourced from ORCCC.



Transmission electron microscopy image of an exosome from an oral cancer cell line. This is part of the PhD project of Mohammad Aziz.

Funding highlights

Analysing expression of heat shock proteins and oncogenes associated with cell cycle and proliferation within exosomes derived from oral cancers. M Aziz, B Seo, HM Hussaini, M Hibna, AM Rich. Funding: New Zealand Dental Association Research Foundation Grant 2018-2019. \$15,000

Type 2 diabetes – How do human dental pulp cells respond to glucose and lipopolysaccharides? LT Friedlander, S Al Samahi, T Milne, HM Hussaini, AM Rich. Funding: New Zealand Dental Association Research Foundation Grant 2018-2019. \$14,890

Expression of vascular endothelial growth factor and associated pathways in oral squamous cell carcinoma. HM Hussaini, HL de Silva, EAST Edirisinghe, T Milne, AM Rich. Funding: New Zealand Dental Association Research Foundation Grant 2018. \$14,496

The regulation of galectin- I and implications for epithelial – mesenchymal transitioning in oral squamous cell carcinoma. P Greer, D Coates, B Seo, HM Hussaini, AM Rich. Funding: New Zealand Dental Association Research Foundation Grant 2017-2018. \$14,584

Human papillomavirus in oral verrucal-papillary lesions: detection by polymerase chain reactions. EP Williams, D Coates, B Seo, HM Hussaini, AM Rich. Funding: New Zealand Dental Association Research Foundation Grant 2017-2018. \$13,542

Lymphangiogenesis in metastatic lymph nodes of oral squamous cell carcinoma. N Ibrahim, BL Seo, AM Rich. New Zealand Dental Association Research Foundation Grant 2016-2018. \$10,800.

IL33 and IL35 expression in healthy and diseased gingival tissues. VPB Parachuru, W Duncan, E Knight. New Zealand Dental Association Research Foundation Grant 2016-2018. \$14,988.

Investigation of the presence of human papillomavirus in verrucal-papillary lesions of the oral cavity and comparison of viral detection methods. E Williams, BL Seo, HM Hussaini, D Coates, AM Rich. New Zealand Dental Association Research Foundation Grant. 2016-2018. \$8,962.

Investigation of the role of lymphangiogenesis in oral lichen planus. J-Kjung, BL Seo, AM Rich. New Zealand Dental Association Research Foundation Grant 2016-2017. \$12,114.

Type 2 diabetes and inflammatory markers in dental pulp. L Friedlander, S Al Samahi, AM Rich, HM Hussaini, T Milne. Ministry of Health Oral Health Research Fund Grant 2016-2018. \$14,891.

Expression of STAT 3 and cytokines (IL22, IL23, Th17) within metastatic lymph nodes of oral squamous cell carcinoma. HM Hussaini, A Alkharusi, AM Rich. New Zealand Dental Association Research Foundation Grant 2015-2017. \$12,134.

The effect of mechanical strain on the unfolded protein response of periodontal ligament cells in a three-dimensional culture. FA Firth, B Seo, T Milne, M Farella. New Zealand Dental Association Research Foundation Grant 2015-2017. \$15,000.

Oral cancer cells under stress: The intertwined roles of cell stress and the dynamic signalling pathways. M Yakin, BL Seo, AM Rich. New Zealand Dental Association Research Foundation Grant 2015-2017. \$15,000.

Angiogenesis in the apical papilla of immature permanent teeth associated with healthy and inflamed dental pulps. LT Friedlander, H Navani, AM Rich, T Milne, P Cathro. New Zealand Dental Association Research Foundation Grant 2015-2017. \$14,990.

Effect of cigarette smoke on TGF- β expression in oral tissues and cells. HM Hussaini, H Narayan, T Milne, AM Rich. Ministry of Health Oral Health Research Fund Grant 2015-2017. \$10,517.

In vitro effect of cigarette smoke on DNA methylation in oral epithelial cells. H Narayan, HM Hussaini, T Milne, AM Rich. Ministry of Health Oral Health Research Fund Grant 2015-2017. \$15,489.

Key publications

Al-Hassiny, A., Friedlander, L. T., Parachuru, V. P. B., Seo, B., Hussaini, H. M., & Rich, A. M. (2018). Upregulation of angiogenesis in oral lichen planus. *Journal of Oral Pathology & Medicine*, 47(2), 173-178. doi: 10.1111/jop.12665

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Sir John Walsh KBE (1911-2003) made such a remarkable contribution to dentistry in New Zealand that Chapter 8 of Tom Brooking's *A History of Dentistry in New Zealand* is entitled 'The Walsh Era 1947-1972.'

After graduating with a first class honours degree in dentistry, followed by a medical degree, and then serving as a medical officer in the Royal Australian Air Force, this self-described 'brash Australian' was appointed as the third Dean of the School of Dentistry at the University of Otago in 1946, at just 34 years of age.

Walsh was a powerful advocate for research. Staff in the Faculty of Dentistry were encouraged to undertake PhD study. The School of Dentistry set out to grow its own researchers by introducing the highly successful Master of Dental Surgery graduate programme. Some fifty years later this degree was replaced by the Doctorate in Clinical Dentistry featuring a considerably expanded research component. This increased the research experience and clinical expertise of graduates in a world where biological knowledge, and its impact on clinical practice, are changing at an unprecedented rate. This initiative undoubtedly would have been endorsed by Walsh.

One of his most significant, but least well-known achievements, was developing a high-speed dental handpiece. Early electric drills were inefficient and caused considerable discomfort to patients. While testing the hearing of Australian airmen Walsh not only identified frequencies that caused pain, but also those that did not. This led to the hypothesis that the vibrational frequencies from sufficiently high speeds could minimise patient discomfort.

With the assistance of H.F. Simmons from the University of Otago Department of Physics, an existing air-powered low-speed drill was modified to operate initially above the 42,000 rpm vibrational threshold, and then at 60,000 rpm. In 1947, Walsh persuaded the Ministry of Science and Industry to underwrite the development of the air turbine handpiece at the Dominion Physics Laboratory in Lower Hutt.

By 1949, a prototype was made, Walsh then obtained the results that contributed to his DSc (Doctorate of Dental Science) from the University of Melbourne, and a New Zealand patent.

Although the prototype overcame the pain problem, its high-pitched noise, excessive exhaust of air into the patient's mouth, and the too-frequent seizure of its primitive bearings due to overheating, made it difficult to obtain further support from government or commercial sources. American and Swedish researchers had overcome the technical problems in the mid-1950s to produce the Borden Airtor.

Walsh expanded research activity within the Faculty by attracting research funding. He established the Biochemical Research Unit within the Dental School in 1960, now the Molecular Biosciences Laboratory, and supported an electron microscopy suite, now reflected in the Otago Centre for Electron Microscopy.

Walsh's appointment advanced dentistry at many levels. He served as a spokesperson for dentistry at the World Health Organisation. He led a campaign that overcame vociferous opposition to fluoridate water supplies. He was knighted in 1960 and awarded honorary life membership of the New Zealand Dental Association in 1971. After 10 years of struggle he succeeded in building the iconic, heritage-listed glass curtain building that houses the Faculty of Dentistry and bears his name.

Fittingly, the redeveloped Walsh Building is to be retained as the centrepiece of the new University of Otago Faculty of Dentistry precinct, to be opened in 2020.



Sir John Walsh at his desk in the Otago Dental School, 1940s. Hocken Collections, Uare Taoka o Hākena, University of Otago.

With thanks to the staff and students of the Sir John Walsh Research Institute and Faculty of Dentistry, University of Otago.

1869-2019



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YEARS

Sir John Walsh
Research Institute
Research Day 2018

Auditorium



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