



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

# Research Highlights

2015-2016



# Sir John Walsh Research Institute Highlights 2015-16

The Sir John Walsh Research Institute (SJWRI), a Research Centre of the University of Otago, 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 twenty internationally, 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

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We hope you enjoy *Research Highlights of the Sir John Walsh Research Institute*, a snapshot of our research activities and achievements for 2015-16. If you would like more detail, our full *Research Report of the Sir John Walsh Research Institute* will be released later in 2017, including individual research profiles for all SJWRI staff members, and full listings of all SJWRI publications and research funding for the 2015-16 period. Alternatively, details on our research programmes, activities and achievements, and profiles of researchers are available from our website [otago.ac.nz/sjwri](http://otago.ac.nz/sjwri)

**Dr James Smith**

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Compiled by James Smith, SJWRI Research Manager

With thanks to Prof Richard Cannon, Nicole Summerfield, and the staff and students of the Sir John Walsh Research Institute.

# Introduction from the Dean



The University of Otago's Faculty of Dentistry is, as we all know, very highly regarded within New Zealand and internationally for its excellence both in research and dental education. The Faculty's very diverse, research portfolio covers a wide variety of fields and research in the Faculty is quite simply outstanding. This I am sure will be reflected in the next PBRF round, for which we are currently preparing, where I am sure we will see the excellence of our research acknowledged. The quality of our research and the reputation of the Faculty of Dentistry has recently been further recognised by the QS rankings which have placed the School in the top 20 of all Dental Schools internationally.

Our centre of excellence in dentistry was also this year the most highly ranked (QS rankings) University department across all New Zealand. This tells me that this success is all about the people who work in the Faculty, given the state of the various buildings the Faculty currently occupies. We are, of course, getting a brand new school and facilities and we plan to develop the dental school and extend its footprint into the North Island as many of you will be aware. This is an exciting time for the Dental School because we can build on our, as I say, excellent reputation in the new facilities when we plan to excel even further. This is crystallised in our vision for the future to be a Top 10 Dental School by 2025. We plan in 2017 and beyond to grow our clinical and translational research which will further complement our existing research themes.

I congratulate Professor Richard Cannon and all the team involved within the Institute for their research accomplishments and wish them all the very best for the future.

**Professor Paul Brunton**  
Dean, Faculty of Dentistry  
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# Report from the Director



The Sir John Walsh Research Institute (SJWRI) was established in 2007, and so it is approaching its 10th anniversary. This is, therefore, an appropriate time to look back at our achievements and plan for the next decade. University of Otago Faculty of Dentistry oral health, dental, and biomedical research is carried out within SJWRI research programmes. Since their inception, these areas of research strength have gradually evolved. This year, for example, the Clinical Research programme has become the Clinical and Translational Research programme. This highlights the desire of the SJWRI to 'translate' research results into clinical, social, educational, and economic benefits with the aim of increasing the effect, or impact, of the research. There are, indeed, translational components to all of the other research programmes that include: the development of new materials; devices or technologies; new teaching modalities; or new ways of treating patients and delivering services.

Over the last two years the SJWRI has continued to develop a Practice-Based Research Network called ARCH (Applied Research through Clinicians' Hands). This network is a collaboration between researchers in the SJWRI and community practitioners in which they undertake, primarily, clinical research of mutual interest to enhance patient care and delivery, systems assessment, quality assurance, and other factors affecting health care policy. Importantly, the topics to be investigated come from the practitioners, and so it is highly likely that research outcomes will be 'translated' or implemented in clinical practice.

Research that remains unread, unused or unimplemented is of limited value. Traditionally, the outputs of research are articles published in books or scientific journals; however, if the target audience does not read the journal, the potential impact of the research is reduced. As you will see from the information presented in this report, the SJWRI produces a broad spectrum of research outputs from the theoretical to the applied, and while we have great success publishing our research in high impact journals, in the last two years we have sought to expand the impact of our work by communicating our research through specialist journals, magazines, electronic, social and other media, including a regular slot on oral health by Professor Murray Thomson on National Radio. Conferences remain a good way of disseminating research findings through the scientific community and this year, for the first time, the SJWRI had an exhibition booth at the General Session of the International Association for Dental Research, in Seoul, Republic of Korea. The SJWRI also disseminates its research results through its own mini-conferences, and accounts of the successful 2015 Research Day and the 2016 Research Symposium are included in this research report.

A recent initiative by the SJWRI has been to increase community engagement by explaining the science behind dentistry and dental procedures. This has involved providing hands-on activities at the Otago Museum for World Oral Health Day and taking these activities to schools. With support from the government's Unlocking Curious Minds fund, Dr Carolina Loch has run an activity called Making a good impression: from fossils to false teeth in several primary and intermediate schools. This activity explains the science behind dental impressions, helps the children make impressions and models of animal teeth and, at the same time, delivers messages on healthy diets and the importance of looking after your teeth. The project has generated several short videos on fossils, teeth and dental impressions, aimed at children, that have been uploaded to YouTube and can be accessed through the SJWRI website ([otago.ac.nz/sjwri/resources](http://otago.ac.nz/sjwri/resources)).

Another way SJWRI research has impact is through informing the teaching of undergraduate and postgraduate students. The involvement of Faculty of Dentistry teachers in cutting edge oral health research ensures that graduating students leave with the most up-to-date and effective training possible and an appreciation of the value of research in the continuing improvement of clinical practice. The quality of our research-informed teaching has helped maintain the School of Dentistry in the top 12 Dental Schools in the world in the QS World University rankings in 2015 and 2016.

Looking to the future, the SJWRI wants to continue to find new and more effective ways of communicating, disseminating and implementing research outcomes. These may include the development of novel dental materials, dental devices or clinical procedures, or implementing new paradigms of oral health care policy and delivery systems. Engagement with the users of the research will be through traditional written media and oral presentations at conferences and the popular press and electronic media. We look forward to partnering with other researchers, institutions, organisations and community groups to ensure our research improves oral health in New Zealand and worldwide.

**Professor Richard Cannon**

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# Sir John Walsh KBE

Sir John Walsh 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.

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 MDS (Master of Dental Surgery) graduate programme. Some fifty years later this degree was replaced by the Doctorate in Clinical Dentistry (DCLinDent) 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 DDSc (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. 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. The Walsh Building will be retained and renovated as the centrepiece of the redeveloped University of Otago Faculty of Dentistry complex, to be opened in 2019.



Sir John Walsh at his desk in the Otago Dental School, 1940s. Hocken Collections, Uare Taoka o Hākena, University of Otago. (Reference S11-534d)



# Our Highlights



# Publications and Research Funding summary 2015-16

## Publications Summary, 2015-16

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. Data courtesy Dr Donna Hendry, Publications/Outputs Office.

Category	2015	2016
Edited Book - Research	1	1
Chapter in Book - Research	10	3
Chapter in Book - Other	1	0
Journal - Research Article	75.09	85.6
Journal - Research Other	6.47	4.42
Journal - Professional & Other Non-Research Articles	25	15
Conference Contribution - Published proceedings: Abstract	76.85	59.25
Conference Contribution - Poster Presentation (not in published proceedings)	2.5	0
Conference Contribution - Verbal presentation and other Conference outputs	9.5	10
Other Research Output	1	2
Awarded Doctoral Degree (Staff member only)	2	0
<b>Total Unique Publication Counts for SJWRI/Dentistry</b>	<b>210.41</b>	<b>180.27</b>

## Research Funding Summary 2015-16

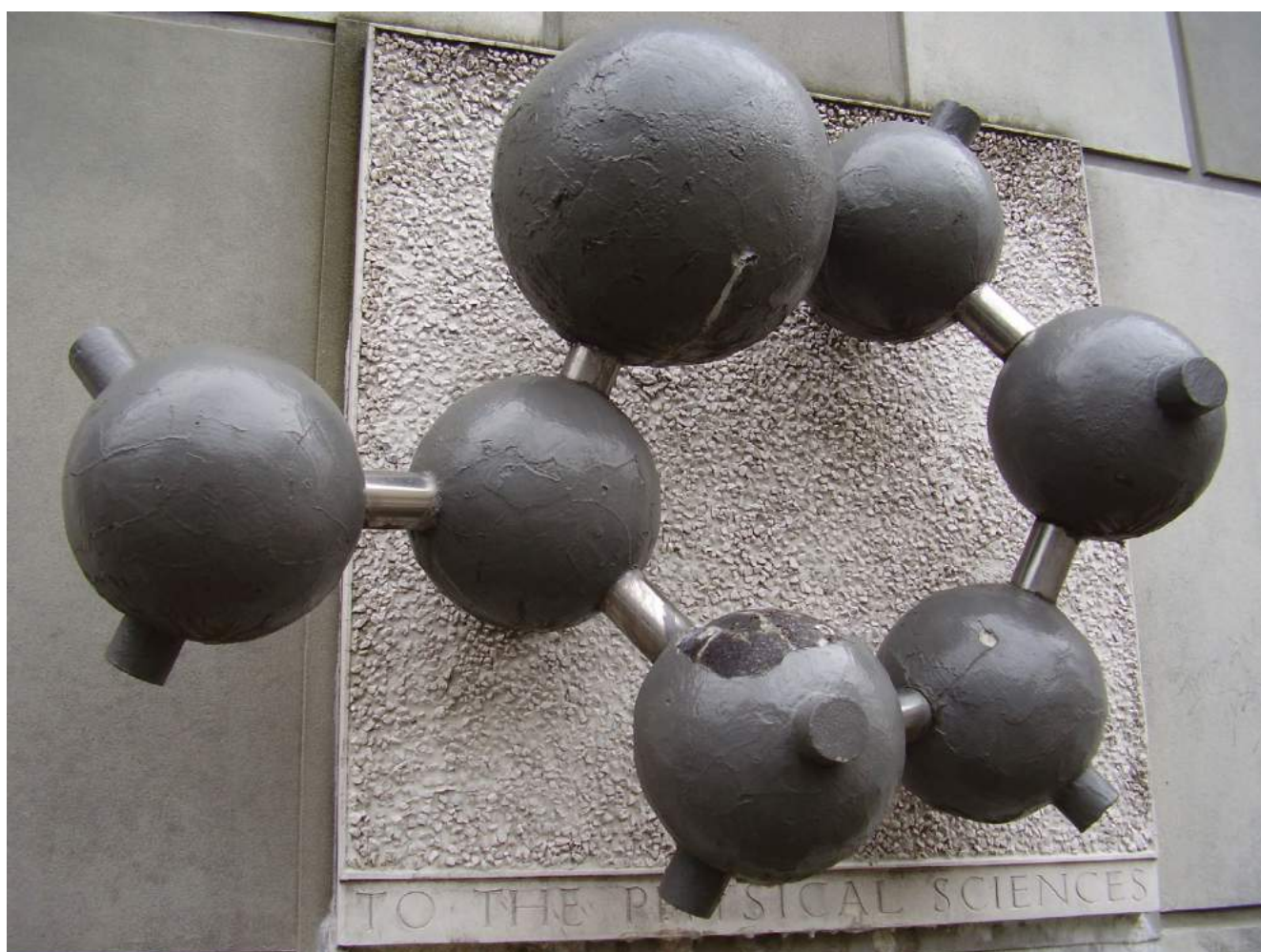
Figures below are for all research funding contracts beginning between 1 Jan 2015 and 31 Dec 2016, led by Sir John Walsh Research Institute/Faculty of Dentistry Principal Investigators. This does not reflect contracts beginning in earlier years which ran through the 2015-16 period. Research funding data courtesy Dr John Milnes, Research and Enterprise.

Contracting Body	Total
Cure Kids	\$31,782
DMG Dental Materials Gesellschaft mbh	\$32,068
Downie Stewart	\$34,916
Foundation for Orthodontic Research & Education, NZAO (FORENZAO) Charitable Trust	\$9,668
Health Promotion Agency	\$10,000
Health Research Council of NZ (HRC)	\$2,391,489
Manuka Health New Zealand Ltd	\$56,428
Maurice and Phyllis Paykel Trust	\$45,500
Ministry of Business, Innovation and Employment	\$2,225,778
Neurological Foundation of New Zealand	\$12,000
New Zealand Dental Association Research Foundation and Ministry of Health Oral Health Research Fund (administered by NZDARF)	\$368,582
New Zealand Lottery Grants Board	\$251,150
New Zealand Society of Gastroenterology Inc	\$5,000
New Zealand Society of Periodontology	\$8,000
Otago Innovation Limited	\$30,000
Resorba Medical GmbH	\$53,430
University of Otago	\$220,617
Wiley Periodicals Inc	\$144,800
<b>Grand Total</b>	<b>\$5,931,208</b>

# Postgraduate Degree Completions 2015-16

Figures below are for all postgraduate degree completions between 1 Jan 2015 and 31 Dec 2016, for which the SJWRI or other Dentistry departments were listed as host department.

Degree	2015	2016
Doctor of Philosophy (PhD)	3	6
Doctor of Clinical Dentistry (DClinDent)	8	12
Master of Dental Technology (MDentTech)	0	2
Master of Dental Surgery (MDentSurg)	1	0
Postgraduate Diploma in Clinical Dentistry (PGDipClinDent)	2	3
Postgraduate Diploma in Clinical Dental Technology (PGDipCDTech)	24	8



# World ranking successes



The 2015 and 2016 QS World University Subject Rankings identified the University of Otago's Faculty of Dentistry as among the top 10 best in the world. Dentistry was included as a subject for the first time in 2015, with Dentistry at Otago ranked 8th in 2015 and 12th in 2016.

Dentistry is the highest-ranked subject from any New Zealand university, and the first subject taught at a New Zealand University to ever feature in the world's top ten. Dentistry was joined by Psychology (ranked 31st) as one of two Otago subjects to feature in the world's top 50 in 2015; a feat repeated in 2016.

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.

University of Otago Vice-Chancellor Professor Harlene Hayne said she is delighted that the School of Dentistry's international reputation for excellence has been formally recognised through the QS rankings.

"I would like to pay tribute to the School's staff for their commitment to providing high quality undergraduate and postgraduate education while also undertaking internationally leading research," Professor Hayne said.

The University had already identified the School as a top performer and made a strategic decision to invest in a major re-development of its facilities, she said.

Deputy Vice-Chancellor (Academic) Professor Vernon Squire said that Otago's pleasing showing in the QS subject rankings reflect Otago's broad and deep capabilities across a range of academic disciplines.

"Our solid performance in these rankings follows the University last month [February 2016] being awarded the highest possible international quality rating of five stars plus from QS Stars rating system," Professor Squire noted. QS Stars is a quality evaluation system in which universities are assigned a stars rating based upon their performance in an institution-wide review.

The five star plus rating is a mark of quality and excellence that is awarded to universities described by QS as "an institution (that) is not just world-class, but an elite destination to which the very best students and faculty worldwide will aspire. Its brand name will transform the résumé of anyone connected with it".

# Building programme

The University of Otago Council has agreed to spend in excess of \$125 million on a state-of-the-art new Dental School.

"The University Council and executive are delighted to now be in a position to announce the plans to the wider University and the Dunedin community," said University Chancellor John Ward and Vice-Chancellor Professor Harlene Hayne in a joint statement issued in April 2015. "These substantial developments will give the University a significant boost nationally and internationally, and will reinforce our stellar reputation for teaching and research. Quality environments and technology of the highest possible standards are vitally important as we go forward as a leading New Zealand research and educational institution."

These buildings will be tasteful, modern and energy efficient, deploying the latest construction methods, and they have been designed with great care to ensure they reflect our already world-class campus setting.

"We are investing in the quality of our educational environment at a time of intense competition in the tertiary sector both nationally and internationally. Both projects will also give Dunedin and Otago citizens a major injection of confidence that the city is in good heart. The level of construction on campus will be on a scale that has not been seen for many years and will provide a significant boost to the regional economy. We believe that these projects, on completion, will provide substantial benefits for our staff, students and patients."

The University appointed Jasmax, an Auckland-based architectural firm that has experience in providing hospital-type facilities for the design work for the new Dental School. In keeping with values in the 2010 Campus Master Plan, the research and teaching facility, which undertakes all the dental training for New Zealand, will reflect excellence in architecture.

The heritage-listed glass-curtain facade will be replaced with a replica facade that meets current standards of weather-proofing and technology. The mosaic north-facing wall will also be strengthened and renovated, with both aspects to be undertaken with the assistance of Salmond-Reed Heritage specialists. There will also be ongoing consultation at each stage of this adaptive re-use project with Heritage New Zealand, which lists the modernist building as a Category 1 historic place.

The Dental School's original Walsh Building was constructed in Great King Street in 1961, with the West Wing extension completed in 1981, behind the original building and next to the Dental School car park.

To make way for the new Clinical Services Building, the non-listed west wing extension and the remainder of the University's Barningham building behind the

existing Walsh building were removed. The new 8000 square metre clinical building, as well as an 1800 square metre atrium and "social space" linking it to the Walsh building, is being constructed on this footprint.

The 8000 square metres of space in the Walsh building will be refurbished to house laboratories for research, academic offices, student support and teaching spaces.



The future ... An artist's impression of the atrium which will link the Faculty of Dentistry's new School of Dentistry Building and the refurbished Walsh Building.



An artist's impression of the interior of the new School of Dentistry.



An artist's impression of the exterior of the new School of Dentistry.

"The new building will have its own look, but in size and scale it will link back to the heritage and existing architecture of the 1960s Walsh building," said Property Services Director Barry MacKay.

This clinical building will house clinical services including radiology, oral surgery, paediatric dentistry, undergraduate clinics and orthodontics that are currently housed in the Walsh building. In total there will be 211 new dental chairs, 61 more than the existing dental school.

Large multi-national company Sirona Dental has been confirmed as the supplier for all the School's dental and radiography equipment, so several partnering initiatives are being set up with the firm; including further education, research, product testing, and forums with other universities.

"This is seen as an exciting and strategic relationship for the University, now and for the years ahead," said Mr MacKay.

Dean of the Faculty of Dentistry Professor Paul Brunton said staff at the Dental School are excited that the plans have advanced to this stage.

"The physical environment is really important not only for staff and students, but also for the patients who access our clinical services.

"The Faculty already has an excellent reputation, but a new facility will allow us to grow, develop and innovate such that I anticipate we will, in due course, be the best of the best in Australasia and beyond."

Learn more about the new University of Otago Faculty of Dentistry building project, featuring interviews with staff, students and neighbouring business owners: [youtube.com/watch?v=0hz7Eq3znCU](https://youtube.com/watch?v=0hz7Eq3znCU)

## Contractor appointment

In August 2016, the University's Project Working Party approved the appointment of the contractor on Wednesday 3 August, and Leighs Cockram JV, a joint venture company made up of Christchurch-based Leigh's Construction, and Australian-based Cockram's Construction, was subsequently notified.

The appointment came after a two-stage open tender process run via the Government tendering website over 12 weeks. At the conclusion of the process, which evaluated price and non-price attributes of tenders such as construction methodology, quality management, experience with similar projects and managing the links between the existing operations, services, and the new build, Leighs Cockram JV scored the highest and were recommended as contractor. The total value of the project, which includes

demolition, the construction tender just announced, and then fit-out with all equipment and furnishings, has been estimated at around \$125 million.

University Chief Operating Officer Stephen Willis says the joint venture of Leighs and Cockram brings a unique level of experience and appreciation for health-related facilities, and they are "among a few in New Zealand that we believe are capable of successfully delivering a project of this size and complexity."

"Leighs Cockram JV brings with them recent relevant experience with a number of the team having just completed the Burwood Hospital project in Christchurch. We also know there will be significant engagement locally from the sub-contract and labour market, which is fantastic for Dunedin, and the local economy.

"It's great to see all the hard work paying off to get to this stage. All the stakeholders, including the Faculty of Dentistry, the Division of Health Sciences, University Property Services and our students, are incredibly excited to finally be starting construction," he says.

The project managers, Aurecon, who were appointed in late 2015 have, in conjunction with the Faculty of Dental and University, re-thought the staging and decanting methodology, resulting in a single-stage redevelopment of the Walsh Building. Originally this was going to be done in two stages, with half the building occupied during construction. A revised decant strategy will see research, dental technology, histology and some teaching temporarily relocated predominately to the northern end of the campus. The project team has focused on utilising existing space, as opposed to building new temporary space. It is likely the temporary facilities will be in use for 18 months to two years.

"This (strategy) will result in a shorter programme, as well as making it safer and more comfortable for students, staff and patients during the works. The new clinical school building will be constructed first and is anticipated to be complete mid-2018, at which point the existing Walsh building will be vacated and refurbished with completion expected in mid-2019."

The process of appointing a main contractor for the construction of Otago's new Faculty of Dentistry included evaluating the company's "innovation and consideration" for the Faculty's existing activities throughout the project. The Faculty provides the only dental training in New Zealand, and treats patients from the community as part of that training.

Associate Dean, Capital Build, Don Schwass says minimising disruption is a very high priority, "but the practicality of expensive multi-million dollar building contracts – with performance penalties – prevents all disruption being avoided."

## Archaeological finds on Faculty of Dentistry site

Artefacts painting a picture of some of Dunedin's early residents were unearthed by staff of Otago's Department of Anthropology and Archaeology as site preparation for the University's Faculty of Dentistry redevelopment got underway in early 2015.

Early preparation work for the much anticipated redevelopment identified the site as part of a once-bustling domestic and light-industrial centre of the still young, but rapidly growing city of Dunedin.

Research Fellow, Emma Brooks says early photos and plans show that from at least the 1860s the land behind the current Faculty of Dentistry contained shacks, workshops and houses as well as a set of buildings associated with the Victoria Foundry run by Barningham and Co in the late 19th century.

The University was required under the Heritage New Zealand Pouhere Taonga Act to commission an archaeological investigation of the site in order to identify, record and provide an interpretation of all earlier structures and work zones on the site and has been able to harness in-house expertise. The archaeological work is being carried out by a team from Southern Pacific Archaeological Research (SPAR), a research and consulting unit within the Department of Anthropology and Archaeology. The work is led by SPAR Director Professor Richard Walter, with other SPAR staff and graduate students. Ms Brooks is SPAR's Research Manager.

"Careful planning between Property Services and the SPAR team has resulted in the commencement of the

archaeological investigation of the site well ahead of the construction schedule to ensure that any possible delays as a consequence of archaeological finds can be avoided," Ms Brooks said.

"The archaeologists have started work underneath the Barningham Building (one of the former foundry buildings) which has recently been demolished and which until recently housed the Multi-Disciplinary Health Research Unit, and Property Services itself, prior to that," she said.

The team exposed several features associated with 19th century structures on the site, including a cobblestone floor, rows of well-preserved timber posts, and timber-lined drains. Many artefacts have been recovered, including many pairs of leather boots and shoes, clay pipes, bottles and ceramics, and these have the potential to reveal information about the nature of activities that took place on the site.

"This was not a wealthy part of Dunedin and on this city block houses were crammed in with commercial and industrial activities," said Professor Walter.

Professor Walter said these archaeological finds contribute to our understanding of Dunedin's past and help build up a picture of how early residents lived and worked.

"It is not often that you get to carry out an archaeological excavation right on your back doorstep. This has provided a valuable training opportunity for many of our students who are planning careers as professional archaeologists."



Archaeology staff examine the site of the former Barningham Building for relics of early Dunedin as part of the Dental School redevelopment.

## Time-lapse camera

A time-lapse camera is recording the largest capital redevelopment the University has ever undertaken.

From its spot on top of Zoology's Marples Building in Great King Street, the camera has been snapping the site of the \$125 million project since February 2016, taking a photo every minute.

Those images can already be seen refreshing every 10 seconds at [otago.ac.nz/dentistry/about/new-building-project](http://otago.ac.nz/dentistry/about/new-building-project)

Camera footage of the activity lets people get an instant visual update on the rebuild from wherever they are, including alumni, dental and academic colleagues, and students off campus.

The final footage will also interest people involved in planning, development and construction, along with the public and project stakeholders.



## Expected timeframes

<b>Early 2017</b>	Continuing detailed excavation, piling and in-ground concrete works, services diversions and installation.
<b>Mid-Late 2017</b>	Decant of Walsh Building laboratory spaces.
<b>Late 2017-early 2018</b>	Decant of Walsh Building Dental Technology and office spaces.
<b>Mid-2018 -</b>	Expected opening of Clinical Services Building and subsequent handover of the Walsh Building for refurbishment.
<b>Mid-to-late 2019</b>	Completion of Walsh Building

# Staff awards and achievements

## Professor John Broughton awarded Companion of the New Zealand Order of Merit



Professor John Broughton

Professor John Broughton was awarded the Companion of the New Zealand Order of Merit (CNZM) in the Queen's 90th Birthday Honours in June 2016 for his services to Māori health, theatre, and the community.

Professor Broughton said he was not only very proud to be an academic staff member but the University is also "the best employer in the world".

The Professor in Māori Health says he is proud of being an Otago graduate as well.

That is especially because his late father graduated in medicine from the University during World War II, his sister Jane and brother Philip are Otago alumni, and a third generation of nieces and nephews has graduated from the University as well; in Commerce, Law, Physical Education, Physiotherapy and Marketing.

Professor Broughton says the honour should mean a lot for the University because "it is really a reflection of the incredibly wonderful colleagues I have had the privilege of working with" at the Faculty of Dentistry, Preventive and Social Medicine, Te Poutama Māori (which supports the development of Māori academic staff), and the Māori academic staff caucus, along with the students he has had the privilege of encountering.

Professor Broughton feels humbled by the honour, which has made his family very proud, especially the whānau whanui at both Kohupatiki Marae (Hastings on his Ngāti Kahungunu side) and at Puketeraki (Karitane on his Ngāi Tahu side).

The CNZM is also recognition for causes he is passionate about, including being the foundation Chairman of the New Zealand Institute for Cancer Research Trust, a role he has filled for about 30 years.

The Trust helped create the University's Chair in Cancer Pathology by donating a million dollars to the Dunedin School of Medicine, which was matched by a million dollars from the Government, through the Leading Thinkers programme.

Professor Broughton was also founding Director of the Ngāi Tahu Māori Health Research Unit. He is responsible for the cultural competency and Māori oral health component of the dental undergraduate course, and established the whānau dental clinic Te Whare Kaitiaki in the Faculty of Dentistry in 1990. He is Director of the clinic.

As a New Zealand Māori playwright, he has written and co-produced more than 22 theatre productions that have been performed nationally and internationally, and he has received the Bruce Mason Playwright Award. Professor Broughton's plays include Michael James Manaia, Te Hokinga Mai (The Return Home); Nga Puke (The Hills), and ANZAC and The Private War of Corporal Cooper.

He also wrote the libretto for the musical ShowBand Aotearoa, with music by Rim D Paul, and is a Life Member of the Araiteuru Marae Council.

Professor Broughton is also the 2016 recipient of the Maarire Goodall Award, awarded by Te Ohu Rata o Aotearoa—the Māori Medical Practitioners' Association—at the September Hui-ā-Tau Awards Dinner at Papakura Marae, Auckland.

The Award acknowledges and honours long service and unrecognised commitment to Māori health by a Māori health worker, and was established in 1998 by University of Otago alumnus Dr Maarire Goodall.

This award acknowledges and honours John's long service to patients, students, and community, and his commitment to Māori health. John has had a long-term role in supporting students in Health Sciences at Otago, and has made a huge contribution to Māori health in New Zealand through his research and work in the wider community.

Dr Goodall graduated from Otago in the early 1960s. He worked in Thailand for a number of years, and later moved to the United States where he was part of the 'Freedom Riders'—a group of idealists from the north who rode buses into the heart of the southern states in support of the African American struggle for equality.

Dr Goodall worked for nearly four years in Chicago Medical School's Institute for Medical Research, before being called home to lead a cancer research programme at Otago (1966–1985). He then agreed to take up a position at the National Cancer Institute (USA), but was asked to assist with research for the Waitangi Tribunal. He did this for the next five years until ill health intervened. After he retired, Dr Goodall founded Aoraki Press and also founded two charitable cancer research institutes. Dr Goodall passed away in June 2015.



## Professor Alison Rich admitted to Royal College of Pathologists



Professor Alison Rich (left) at the Royal College of Pathologists admissions ceremony for new fellows.

The world-class standard of oral pathologist **Professor Alison Rich's** endeavours has been recognised by the London-based Royal College of Pathologists, which in June 2016 added her to their roll of Fellows after assessing her published works.

Professor Rich said "It's an honour and an achievement to have that international recognition. To be judged by your peers for the quality of your research work is satisfying. I'm a diagnostic oral pathologist, which

essentially means I diagnose lumps and bumps from the oral region, mostly via biopsies sent from dentists and dental specialists from around New Zealand."

As Faculty of Dentistry Deputy Dean, Head of the Department of Oral Diagnostic and Surgical Sciences, and leader of the Oral Pathology training programme, Professor Rich said her Fellowship is useful for staff and postgraduate students.

"It's good that they can be exposed to a different qualification, to see different international options you have for earning further qualifications in oral pathology.

"As a Fellow, I also have access to all the Royal College of Pathologists' databases, expert groups and publications, which is helpful to me and our team and, through that, the Dental School and University as a whole."

Faculty of Dentistry Dean, Professor Paul Brunton said he is "delighted to see that Professor Rich's significant and sustained contribution to Oral Pathology has been recognised with such a prestigious award."

Professor Rich was informed that her Fellowship application had been successful late in 2015 and attended the admission ceremony in March 2016.

"It was held in Middle Temple, an amazing old London building [which had been the Knights Templar headquarters until 1312]. I was one of three people accepted as Fellows in the published works category."

The event may have reminded Professor Rich of how far she'd come since graduating with her undergraduate degree from Otago in 1976. She spent two years in her first job at Christchurch Hospital, then went on to enrol at the University of Melbourne, Australia, for her master's. She was subsequently offered a staff position, but after many years the attraction of family ties drew her back to Dunedin in 1998. She began at the Dental School as a Senior Lecturer in Oral Pathology, working her way up to her current position.

## Professorial promotions

SJWRI Clinical and Translational Research Programme Director **Warwick Duncan** was among a select group of fifteen leading University of Otago academics promoted to full professorships in January 2015, on the basis of their world-class research, teaching and service to the University and community.



Warwick Duncan

Professor Duncan, who also served as Associate Dean (Facilities and Clinical Services) for 2014-15, is the first Otago-qualified periodontist to be promoted to Professor at the University. His 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. Through collaboration with the late Professor Jules Kieser, he has developed research interests in forensic biology and victim identification.

A further 39 University of Otago academics were promoted to Associate Professor in 2015, including Oral Sciences researchers Jonathan Leichter and Brian Monk (Molecular Microbiology) and Neil Waddell (Oral Rehabilitation, Director of our Biomechanics and Oral Implantology research programme).

At Otago, full professorships are conferred only after a rigorous selection process that thoroughly evaluates academic quality and involves input from international experts. Candidates must have demonstrated records of sustained excellence and outstanding leadership in research, teaching, and service to the University and their external communities.

Announcing the new professorships, Vice-Chancellor Professor Harlene Hayne warmly congratulated the new Otago professors on their success.

"These well-earned promotions are going to leading academics from across our Dunedin, Christchurch, and Wellington campuses and clearly reflect the range and depth of world-class scholarship at this university."

**Darryl Tong** was one of 17 University of Otago academics who were promoted to full Professor, effective 1 February 2016.

A specialist in oral and maxillofacial surgery in the Department of Oral Diagnostics and Surgical Sciences and a Lieutenant Colonel in the New Zealand Army Reserves, Tong



Professor Lieutenant Colonel Dr Darryl Tong

has a wide range of research interests including clinical (trauma and military surgery), biomechanical (forensic biology and subconcussion in sports), historical (development of maxillofacial surgery) and development of surgical instruments for commercialisation. His current research includes the quantification of subconcussive forces to the head and how it relates to potential long-term brain injury especially in sports and the martial arts; the development of an anatomical head model (which incorporates a simulant skin, skull and brain) for forensic blunt and ballistic trauma research and war surgery of the head, face and neck relating to operational deployment in areas of conflict, personal protective equipment and lessons learned from military medical history. He is the co-director of the South Island Interdisciplinary Brain Injury Research Group (SIBIRG) and part of the management committee for the Veterans' Health Research Group (University of Otago Research Theme).

His recently-completed PhD consisted of a historical review of the development and evolution of face-and-jaw surgery in warfare; a surgical audit; and a systematic review.

"We know what has been developed and how things evolved since World War I. Certain things work and have done so for almost 100 years, but since medicine has gone to evidence-based practice, the surgical principles so far are anecdotal."

The influence of face and jaw pioneers such as Harold Gillies (the "father of modern plastic surgery") and Henry Percival Pickerill, founding Dean of Otago's Dental School, is still felt today, says Tong. "Most of their surgical principles still apply."

For his surgical audit, Tong compared case studies from World War I with similar cases he worked on in Afghanistan, where he was deployed in 2009. Inspired by his time in Afghanistan, Tong has invented a device to help with the treatment of facial trauma in

hostile environments. His Temporary Inter Maxillary Stabilisation (TIMS) device, developed in collaboration with Associate Professor Neil Waddell, has already received commercial interest in the US.

A further 28 University of Otago academics were promoted to Associate Professor in 2016, including Vincent Bennani (of the Department of Oral Rehabilitation), Lyndie Foster Page and Geoff Tompkins (both of the Department of Oral Sciences).

## Professor Richard Cannon elected President of the NZ Microbiological Society

SJWRI Director Professor Richard Cannon was elected President of the New Zealand Microbiological Society (NZMS) at its Annual Conference in Rotorua, November 2015.

Richard is Professor of Molecular Microbiology in the Department of Oral Sciences, and former director of the SJWRI Molecular Microbiology research programme before taking up his current position of SJWRI Director and Associate Dean (Research) of the Faculty of Dentistry. He undertook his biochemistry and microbiology training at the University of Cambridge, UK. His main research interest is in oral yeast: how they colonise the oral cavity; how they cause disease; and ways of preventing them causing disease.



Professor Cannon's first duty as new NZMS president was to present the highest honour of the society, the 2016 NZMS Orator Award, to Associate Professor Mary Nulsen of Massey University (pictured left with Prof Cannon).

His particular research interests focus on the human pathogen *Candida albicans*, which causes both oral candidosis and life-threatening disseminated disease. He uses molecular approaches to determine how *C. albicans* adheres in the mouth; what makes it pathogenic; how it becomes resistant to antifungal drugs; and how its drug resistance can be overcome. Richard also uses baker's yeast, *Saccharomyces cerevisiae*, as a tool to investigate fungal membrane protein structure and function.

The aim of the NZMS is to foster the generation and dissemination of knowledge of microbiology in New Zealand through networking, student support, special interest groups, a newsletter, and awards. The aims of the Society are further met by representation on national and international committees, and organisation of an annual scientific meeting and smaller workshops organised around specific themes. In addition, the society makes submissions on issues relevant to practicing microbiologists or to education policies in New Zealand.

## UNESCO honours Hocken's Pickerill Papers

The UNESCO Memory of the World New Zealand Trust announced the inscription of the Hocken Library's Pickerill Papers on Plastic Surgery onto the New Zealand documentary heritage register for 2015.

UNESCO recognition draws attention to the significance of documentary heritage and the institutions that are its custodians. Inscription on the register raises awareness of the custodian's institutions and promotes the importance of caring for our documentary heritage.

The Hocken Collections Curator Anna Blackman (pictured with the Inscription and William Randall, Chair Auckland Museum Trust Board) says the Hocken Library was "absolutely delighted" to have been successful in its application for the inscription of the Pickerill Papers on Plastic Surgery.



Photo credit: Memory of the World people.

"The inscription is especially timely as one of the University's World War I projects this year has been to digitise a portion of the collection relating to Dr Henry Percival Pickerill's World War I work on the treatment of wounded NZ soldiers," she says.

Doctors Henry Percival Pickerill (1879-1956) and Cecily Pickerill (1903-1988) pioneered significant developments in facial plastic surgery especially for soldiers wounded in warfare, and for children with cleft palate and hare lip deformities. Henry Pickerill was the founding Dean of the Dental School at the University of Otago.

This important medical archive charts the history of the modern specialty of plastic surgery and the pioneering work of the surgeons involved. It is the only collection documenting the history of plastic surgery in a public collection in New Zealand and has been used also by international researchers.

It contains many case files, illustrated with watercolours and photographs that were used both as a medical record and for teaching purposes and now have significance for the families of patients. There is additional aesthetic value in the watercolours of the New Zealand artist Herbert R. Cole recording the progress of the treatment of World War I patients.

"These new inscriptions onto the New Zealand register and the inscription of the Sir Edmund Hillary Archive onto the UNESCO Memory of the World International register make 2015 a significant year for the recognition of the importance of documentary heritage in New Zealand," says Memory of the World New Zealand Trust Chairperson, Dianne Macaskill.

# Conferences and events

## SJWRI hosts highly successful 55th Annual Scientific Meeting of the IADR ANZ Division

The Sir John Walsh Research Institute and the Local Organising Committee of IADR ANZ 2015 would like to thank all those who attended the 55th Annual Scientific Meeting of the International Association for Dental Research Australia and New Zealand Division this August in Dunedin, New Zealand. The meeting was a great success, with 184 delegates attending from more than a dozen countries. More than half of the registrants were students, which is very encouraging for the future of dental research in Australasia and the Pacific.

The scientific programme contained 133 abstracts, with local and international speakers scheduled in a series of plenary and open oral sessions, in addition to poster presentations. The theme for this year's meeting was *Translational Dentistry – from the laboratory to the clinic*, recognising the importance of our research having impact in the clinic and in the community.

Professor Ben Wu was welcomed to IADR ANZ 2015 as the meeting's Colgate Eminent Speaker. Professor Wu is a practicing clinician and biomaterial scientist who is Professor and Chair of the Division of Advanced Prosthodontics at the UCLA School of Dentistry, and also chairs the Department of Bioengineering at the UCLA School of Engineering. His address was on Biomimetic Strategies for Tissue Regeneration.

Other invited speakers included Adjunct Professor Antonio Barone (School of Dental Medicine, University of Pisa, and Co-Director, Division of Oral Surgery, Versilia Hospital, Italy), Professor Paul Brunton (Faculty of Dentistry, University of Otago, New Zealand), Associate Professor Konstantinos Michalakis, (Department of Prosthodontics, Aristotle University of Thessaloniki School of Dentistry, Greece), and Professor Svante Twetman (Department of Dentistry, University of Copenhagen, Denmark), who delivered keynote presentations as part of the plenary sessions.

An IADR ANZ council meeting and an ACODS (Australasian Council of Dental Schools) meeting was held on Sunday, 23 August, preceding the Annual Scientific Meeting, which opened at the Dunedin Public Art Gallery on the morning of Monday, 24 August and ran through to the afternoon of Wednesday, 26 August. The Colgate Welcome Reception was held on the opening evening of the conference at the Dunedin Public Art Gallery, with the Conference Dinner held at the recently restored Toitū Otago Settlers Museum on the Tuesday evening.

Our highly successful hosting of IADR ANZ 2015 would not have been possible without the generous support of our sole sponsor Colgate Palmolive Australia and New Zealand. Special thanks to Dr Susan Cartwright and Dr Rebecca Schipper for the ongoing support and assistance of Colgate.

## Professor Mauro Farella and Dr Jonathan Broadbent win prestigious research awards at IADR ANZ 2015

SJWRI researchers were among the recipients of highly prestigious IADR ANZ Divisional awards presented at the Conference Dinner of the 55th Annual Scientific Meeting, at Toitū Otago Settlers Museum in Dunedin on the night of 25 August.

Professor Mauro Farella, Director of our Craniofacial Biology and Clinical Oral Physiology research programme, was presented with the Division's top prize, the Alan Docking Award, by outgoing IADR ANZ President, Professor Camile Farah of the University of Western Australia.

Dr Jonathan Broadbent of our Dental Epidemiology and Public Health programme won the IADR ANZ Division Investigator Award in Preventive and Community Dentistry. His award was accepted by Dean of the Faculty of Dentistry, Professor Paul Brunton.

Dr Stephen Hamlet of Griffith University on Queensland's Gold Coast was awarded the IADR ANZ Division Oral Biology Award.

Otago students were also successful in the Colgate Poster Competition, with BDS student Danyon Graham winning the Junior competition for his poster presentation 'The molecular basis of triazole inhibition of an antifungal target'. He is pictured below with Prof Camile Farah and Rebecca Schipper of competition and meeting sponsor, Colgate-Palmolive NZ. As the winner of the Colgate Junior Competition, Danyon was supported to attend the IADR General Session meeting in Seoul in June 2016, and entered his research poster into the Hatton Competition at that meeting.

The winner of the Colgate Senior Poster Competition was Jessica Cecil of the University of Melbourne, who competed in the Basic Research category. Runner-up was Chakrabhavi Gundurao Dileep Sharma of Griffith University, who competed in the Clinical/Preclinical category. Runner-up in the Junior competition was Victor Butnejski of the University of Adelaide.



Prof John Broughton (left) and Prof Paul Brunton (right) of the University of Otago's Faculty of Dentistry officially open IADR ANZ 2015.



Colgate Eminent Lecturer, Prof Benjamin Wu of UCLA. Prof Wu's keynote presentation was on using biomimetic strategies as novel methods of tissue regeneration.



Colgate Welcome Reception, Monday evening, in the Donaghy Foyer of DPAG.



Monday poster session.



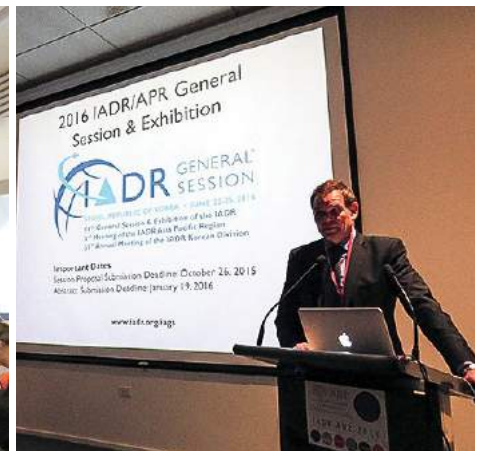
Keynote presenter Prof Svante Twetman, University of Copenhagen.



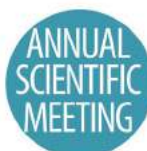
Prof Mauro Farella, winner of the Alan Docking Award, presented by outgoing IADR ANZ President Prof Camile Farah.



IADR ANZ 2015 Conference Dinner, held at Toitū Otago Settlers Museum.



Prof Karl Lyons, Chair of the Local Organising Committee, at the closing ceremony for IADR ANZ 2015.



## SJWRI and Faculty of Dentistry host exhibitor booth at IADR General Session in Korea

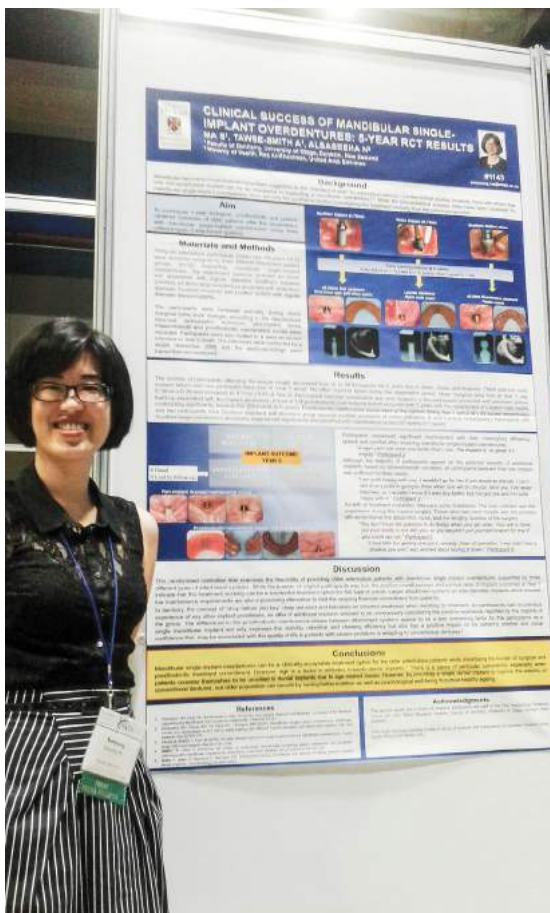
The International Association for Dental Research held their annual General Session in Seoul, Republic of Korea from 21-25 June 2016. This was a joint meeting of the IADR General Session, IADR Asia Pacific Region and our local Australia-New Zealand Division. Some 3,600 delegates were part of the meeting, held in the COEX conference centre in the Gangnam district of Seoul. The SJWRI and Faculty of Dentistry were well represented with 16 staff, two postgraduate and three undergraduate students attending.

As a President's Circle member of the IADR, the Faculty of Dentistry hosted a booth at the Exhibition, coordinated and run by the SJWRI, to promote the activities and achievements of the Institute and the Faculty. The booth proved to be very popular amongst attendees and also offered a focal point for the NZ attendees. Thanks go to Dr James Smith from the SJWRI for all his efforts organising and staffing the

booth. An Otago alumni event was held on the opening night of the meeting.

The achievements of several SJWRI researchers were recognised through a number of awards presented at the meeting. Associate Professor Nick Chandler was awarded the ANZ Division Alan Docking Science Award (the highest award made by the Division); Dr Sunyoung Ma was awarded the J. Morita Junior Investigator Award for Geriatric Oral Research Second Prize in Post-doctoral category for Best Presentation in Geriatric Oral Research; and Chuen Lin Hong, 5th-year BDS student was runner up in the ANZ Division Colgate poster competition and will get to present her work at the IADR General Session in San Francisco in March 2017.

Congratulations to all.



Dr Sunyoung Ma presenting her poster at IADR 2016 in Seoul.



The Faculty's booth at IADR 2016

## SJWRI Research Day 2015

Our 2015 SJWRI Research Day was held on Thursday 9 July at the Dunedin Public Art Gallery in the Octagon. Research Day is our annual celebration of the research achievements of the SJWRI and Faculty of Dentistry, featuring presentations from academic researchers and postgraduate students, a research poster competition, and the presentation of the SJWRI Awards for 2015. Research Day also saw the launch of our 2013-14 SJWRI Research Highlights, our two-yearly snapshot of research achievements, news and events within the Institute and the Faculty.

Following a mihi whatakau delivered by Professor John Broughton on the theme of 'Special Operations in Dentistry', the meeting was opened by Deputy Vice-Chancellor (Research & Enterprise) Professor Richard Blaikie, whose address touched on the recent success of Dentistry at Otago being ranked in the top ten worldwide.

Professor Paul Brunton, on his inaugural Research Day as Dean of the Faculty, gave a keynote presentation outlining his vision for the future of oral health and dental research in the Faculty, at Otago and nationwide. Following this, Director of the SJWRI, Professor Richard Cannon, presented the SJWRI Awards for 2015 (see separate story).

In addition to the Dean, our keynote staff research presentations were given by Research Fellow Dr Dawn Coates, on her work in bisphosphonate-induced necrosis of the jaw, and by Professor Mauro Farella, who outlined the Institute's research aims and achievements in Craniofacial Biology and Clinical Oral Physiology, an emerging research programme of the SJWRI. Professor Farella was later awarded the Institute's premier research prize, the Sir John Walsh Award for Research Excellence.

As in previous years, a selection of our doctoral research students (PhD and DClintDent candidates) presented their research to the meeting, with prizes awarded for the best postgraduate oral presentation. The research poster competition, introduced last year for staff, undergraduate and postgraduate students, was also held again this year.

### Student Oral Presentation Award

Olivia Apperley and Sobia Zafar (joint award)

### Staff Research Poster Competition

Dr Li Mei

### Postgraduate Research Poster Competition

Allauddin Siddiqi

### Undergraduate Poster Competition

Tony Lin and Joyce Yu (joint award)

For the first time, Research Day met social media, with the meeting being live-tweeted on the Institute's Twitter account @SJWRI. If you missed the event, we've gathered all the #SJWRIResearchDay tweets together in this Storify link:

[storify.com/SJWRI/2015-sjwri-research-day](http://storify.com/SJWRI/2015-sjwri-research-day)

Thanks to all staff and students of the SJWRI and Faculty of Dentistry who helped make our 2015 Research Day such a success.



Our 2013-14 SJWRI Research Highlights was launched at Research Day 2015, with all attendees furnished with a copy.



Pictured with SJWRI Director Richard Cannon, joint winners of the Research Day student oral presentation award, DClintDent students Olivia Apperley (left) and Sobia Zafar (right).



Professor Paul Brunton, on his inaugural Research Day as Dean of the Faculty of Dentistry, outlines his vision for the future of oral health research at Otago and across New Zealand.

## SJWRI Research Symposium 2016



Dunedin Public Art Gallery, site of the 2016 Research Symposium, 2015 Research Day, and IADR ANZ 2015.

The 2016 SJWRI Research Symposium, highlighting the research achievements of the University of Otago's Sir John Walsh Research Institute and Faculty of Dentistry, was held on 1-2 September at the Dunedin Public Art Gallery.

### Bigger and better

Now in its tenth year, our Institute's annual celebration of research excellence was moved to a new date and an expanded two-day format, inspired by the success of the IADR ANZ 2015 meeting hosted by the SJWRI this time last year. The new format allowed the introduction of specialised 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 was a success, with over 140 registrants across the two days of the meeting.

### Programme highlights

The meeting opened with a session on clinical and translational research, chaired by Professor Warwick Duncan. Guest speakers included Professor Ian Tucker, Associate Dean (Research Commercialisation) for the University of Otago Division of Health Sciences, and Del Carlini of Dunedin-based biotechnology company Blis Technologies, offering perspectives on the translation and commercialisation of research.

This was followed by concurrent sessions in the areas of epidemiology and public health, and molecular microbiology, before a poster session on Thursday afternoon. Friday began with a keynote presentation from Professor Alison Rich on oral cancer, and a presentation from sponsor representative Janice Pitt of 3M Oral Care. SJWRI collaborators from across campus were featured in the session on craniofacial biology and clinical oral physiology, with Associate Professor Julia Horsfield of the Department of Pathology and Associate Professor George Dias of Anatomy both presenting their research. Concurrent sessions followed on dental education, oral molecular and immunopathology, and biomechanics and oral implantology, before an awards session closed the meeting.

### Symposium awards

Awards were presented to the best presenter in each of the seven programme sessions, as well as the best undergraduate, postgraduate and staff poster competition entries. Congratulations to the following award winners:

#### Oral presentation awards

##### **Biomechanics and oral implantology**

Frances Ruddiman, DCLinDent candidate  
*Bacterial colonisation around implants restored with aftermarket or original abutments – how does this affect implant osseointegration?*

##### **Clinical and translational research**

Dr Carolina Loch Santos da Silva, Research Fellow  
*From the laboratory to clinical practice and back: ultrastructure and properties of carious deciduous teeth treated using the Hall Technique*

##### **Craniofacial biology and clinical oral physiology**

Gareth Benic, DCLinDent candidate  
*Efficacy of oral probiotics in managing biofilm formation in patients wearing fixed orthodontic appliances*

##### **Dental education research**

Calum Fisher, BDS (Honours) student  
*Development of a social accountability measure for the dental environment*

##### **Dental epidemiology and public health**

Deanna Beckett, Master of Public Health candidate  
*Concordance between the CPQ11-14 ISF:16 and the CHU9D among participants in a clinical trial*

##### **Molecular microbiology**

Gemma Cotton, PhD candidate  
*Silver nanoparticle-based hydrogel for treatment of periodontal disease*

##### **Oral molecular and immunopathology**

Muhammed Yakin, DCLinDent candidate  
*Endoplasmic reticulum stress modulates the pathogenesis of oral cancer through STAT3-pathway-dependent immune responses*



## Poster presentation awards

### Undergraduate student

David Chew, BDS (Honours) student

*Tooth preparation with ultrasonic instrments: effects on enamel and dentine surface bonding*

### Postgraduate student

Lisa Falland, PhD candidate

*Use of agar/glycerol and agar/glycerol water as a translucent brain simulant for ballistic testing*

### Staff

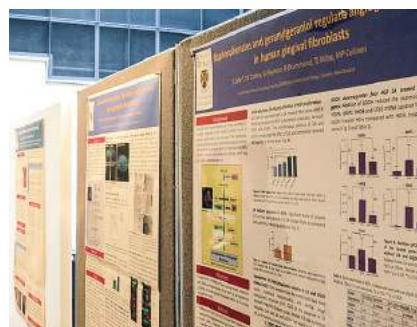
Dr Li (Peter) Mei, Senior Lecturer

*Tongue brushing and oral probiotics for the treatment of halitosis*

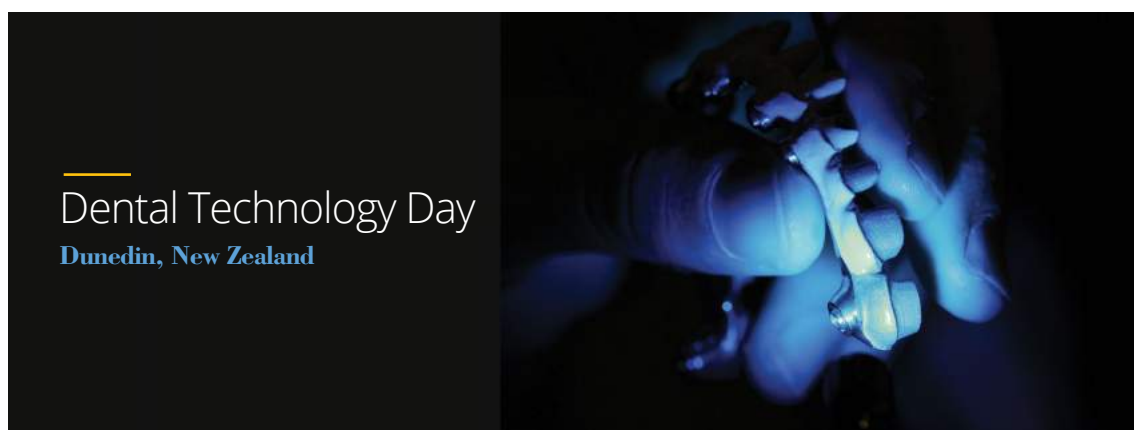
The 2016 Sir John Walsh Research Institute Awards were also presented as part of the closing session.

SJWRI Research Day 2015 and Research Symposium 2016 were made possible by the support of 3M Oral Care.

Programme and abstract books for both events are available for download from [otago.ac.nz/sjwri](http://otago.ac.nz/sjwri)




Research Posters



## Dental Technology Day

For many years the Discipline of Dental Technology has set a day aside in second semester to present the results of research carried out by third-year Bachelor of Dental Technology (BDentTech) and Bachelor of Dental Technology with Honours (BDentTech(Hons)) students. Beginning in 2013, it was decided to invite members of the dental community, in particularly the commercial dental technology sector. The response of the sector was very positive, with 25 qualified dental technicians attending the 2013 meeting from as far afield as Whangarei and Auckland.

In 2014, the event was held at the University of Otago College of Education Auditorium on Saturday 6 September. The attendance increased from 25 to 47, and 7 hours of CPD was allocated for the event. The event was promoted through the newly created Dental Technology Day webpage ([otago.ac.nz/dental-technology](http://otago.ac.nz/dental-technology)). Delegates were able to visit the website, register and pay online. To help offset the costs, funding was provided through the generous sponsorship of 3M ESPE and Healthcare Essentials Ltd. A University of Otago Continuing Education Fund grant was also obtained to support the meeting.



After numerous requests from industry delegates to make this an annual event, it was decided to continue to invite the wider dental sector and formalise the day as part of the SJWRI and Faculty of Dentistry Continuing Professional Development (CPD) events calendar. Over the years the event has expanded to include research and clinical case reports by Postgraduate Diploma in Dental Technology, Master of Dental Technology and PhD students, Dental Technology teaching staff, and academic and research staff from the wider Faculty and SJWRI.

## Dental Technology Day 2015

Dental Technology Day 2015 was organised on the same framework as the 2014 event, but with two major changes. Additional slots were offered resulting in four sponsors for the event: Sirona, 3M ESPE, Ivoclar, and Oraltec. The sponsors was offered a four-hour session to run a CPD course of their choice on Thursday 17 September in the Dental Technology teaching laboratories in the Dental School. All of the sessions were fully booked.

The research presentations took place on Friday 18 September at the University of Otago College of Education Auditorium. The attendance increased from 47 (2014) to 74 qualified dental technicians and seven hours of CPD was allocated for the event. Every year the best undergraduate research presenter is nominated to present their research at the annual New Zealand Institute of Dental Technologists conference. Tay Yoon (BDentTech Student) was nominated to his group's research titled 'The effect if surface treatment on bonding of reline poly(methyl-methacrylate) to denture base resin' at the NZIDT conference in Auckland on Saturday 17 October 2015.

## Dental Technology Day 2016

The Faculty of Dentistry's Discipline of Dental Technology held their fourth annual Dental Technology Day at the University of Otago College of Education Auditorium on 9 September, showcasing research and clinical case reports from Dental Technology staff and students to industry professionals.

This year, Dental Technology Day took place on Friday 9 September at the University of Otago College of Education Auditorium. External attendance increased to 78 registered dental professionals, including dentists and oral hygienists. Feedback from attendees indicated that Dental Technology Day 2016 was a very successful event, with the high quality of Dental Technology research commented on by many delegates. The opportunity to showcase our research to industry is extremely valuable, and also helps students make links with potential employers.

Every year, the best undergraduate research presenter is nominated to present their research at the annual New Zealand Institute of Dental Technologists (NZIDT) conference. Chloe Leong presented her group's research, 'Bond strength of relined soft-liner to poly(methyl methacrylate) denture base material', at the NZIDT conference in Wellington on 14 October.

Next year's Dental Technology Day will be held on 21 September 2017, in collaboration with the NZIDT annual conference which is to be held from 22-23 September 2017 in the Dunedin Town Hall.

## Dental Technology Day 2017

Thursday, 21 September

All members of the dental profession are invited to attend Dental Technology Day on Thursday, 21 September 2017 in the Dunedin Public Art Gallery.

Dental Technology students will present:

- Technical case studies
- Clinical case studies
- New research by final-year Dental Technology students
- Research by Master of Dental Technology and PhD students

This is a great opportunity to visit Dunedin and share in some cutting-edge knowledge, while also qualifying for up to **seven hours of CPD**.

[otago.ac.nz/dental-technology/index.html](http://otago.ac.nz/dental-technology/index.html)

# Sir John Walsh Research Institute Awards for 2015 and 2016

Congratulations to the recipients of Sir John Walsh Research Institute Awards for 2015 and 2016. Our Institute 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

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

### 2015 winner: Professor Mauro Farella

Professor Farella was appointed Professor of Orthodontics at the University of Otago in 2009. An internationally recognized expert in orofacial muscles and temporomandibular joint research, he is the founding director of the SJWRI's research programme in Craniofacial Biology and Clinical Oral Physiology. Professor Farella's research interests include craniofacial growth, craniomandibular function, craniofacial genetics, three-dimensional craniofacial imaging, and sleep bruxism. His current activities are mainly focused on the physiology and pathology of the masticatory muscles and on their relationship to orthodontics, craniofacial growth, and temporomandibular disorders. He is currently also involved in a number of randomised control clinical trials in orthodontics and in clinical gnathology.



2015 Sir John Walsh Award recipient Professor Mauro Farella presenting his research at Research Day.

### 2016 winner: Dr Dawn Coates

Following a post-doctoral research position at the University of Cambridge, and after leading the Bioactive Discovery research group at AgResearch Invermay for a number of years, Dr Coates joined the Faculty of Dentistry as a Senior Research Fellow in 2006. 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). A highly productive researcher and very well regarded supervisor of postgraduate students, Dr Coates is a very deserving recipient of our premier research award for 2016.

## Research Supervisor Award

A new award for 2016, this award is to celebrate outstanding research supervisors of postgraduate and undergraduate students within the Faculty of Dentistry. Nominations were made via a survey process, whereby students were 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. The winner receives \$2,000 towards professional development.

### 2016 winner: Professor Alison Rich

Professor Rich is the leader of the Oral Molecular and Immunopathology research programme within the SJWRI, as well as serving as the Head of the Department of Oral Diagnostics and Surgical Sciences and the Medlab Dental Oral Pathology Diagnostic Service. An Otago BDS graduate, Professor Rich undertook her MDSc and PhD at the University of Melbourne before returning to Otago in 1998. Her research interests are focused on diagnostic oral pathology, particularly oral cancer, on which topic she gave the keynote address to open the second day of SJWRI Research Symposium 2016. As well as being a highly productive researcher in terms of publications, awards and commendations, she has supervised numerous postgraduate and undergraduate research projects since rejoining the Faculty of Dentistry. This award indicates the appreciation, respect and regard in which Professor Rich is held by her students.



Professor Richard Cannon and Sir John Research Award recipient Dr Dawn Coates at Research Symposium 2016

## Basic and Clinical Research Awards

These awards are to acknowledge and promote basic and clinical research by a member of staff or postgraduate student in the Faculty of Dentistry by supporting research development initiatives that could make a contribution to the strategic direction of research within the Institute. The recipients of each award will receive \$5,000 towards their proposed research.

### 2015 Basic Research Award: Dr Jonathan Broadbent

Dr Broadbent is a Senior Lecturer in the Department of Oral Rehabilitation. His research interests include the epidemiology of dental caries, tooth loss, and periodontal disease. He has special interests in dental longitudinal research and inequalities in dental health. Dr Broadbent is Principal Investigator for the dental component of the Dunedin Multidisciplinary Health and Development Study. As part of that project, Jonathan has been working on research relating to blood pressure, lead exposure, fluoride, dental caries, periodontal disease, and ageing. His Basic Research Award proposal involved conducting a clinical audit of human and comparative anatomy specimens held in the Faculty of Dentistry collection, contributing to research capacity within the Institute by enhancing the ability of SJWRI researchers to conduct work pertaining to human oral biology and comparative dental anatomy, enabling staff to more easily identify specimens from the collection that are likely to be of interest/relevance to research, and strengthening and re-establishing links with the Department of Anatomy by using the same electronic template for cataloguing human remains as the Anatomy Museum.

### 2015 Clinical Research Award: Dr Li (Peter) Mei

Dr Mei is a Senior Lecturer in the Department of Oral Sciences. His research expertise is in biofilms and biomaterials. His recent research activities are mainly focused on the mechanism and prevention of bacterial adhesion and biofilm formation on dental materials. His other interests include randomised controlled trials (RCT) and evidence-based dentistry. He has investigated clinical methods for enhancing oral hygiene in patients wearing fixed orthodontic appliances. Dr Mei's Clinical Research Award proposal was titled 'Tongue brushing and oral probiotics for the treatment of halitosis: a randomized controlled trial' and involved conducting a single-blind RCT to investigate the clinical efficacy and synergistic effect of tongue brushing and use of oral probiotic *Streptococcus*

*salivarius* for treating halitosis. Dr Mei went on to present the findings of this research at SJWRI Research Symposium 2016, where he won the Staff Poster Prize.

## 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. This award replaces the Basic and Clinical Research Awards presented in previous years. The recipient receives \$5,000 towards his proposed research.

### 2016 winner: Dr Li (Peter) Mei

The aim of Dr Mei's proposal is to investigate the effectiveness of Air-Flow, a dental procedure which uses a pressurized jet of air, water and abrasive powder, for managing the formation of biofilm in patients with fixed orthodontic appliances.

Biofilm formation causes side effects such as enamel demineralisation, halitosis and tooth decay. Conventional oral hygiene methods are not effective in removing biofilms that form around the brackets and archwires of fixed orthodontic appliances. Air-Flow may be effective at removing biofilms from areas that are difficult to reach, but this needs to be examined clinically. Dr Mei and his collaborators will examine clinical measures of oral hygiene to investigate the efficacy of this approach, as well as biomaterials analysis of the surface topography and roughness of the tooth enamel, brackets and archwires following treatment.



Left: 2015 SJWRI Clinical Research Award winner Dr Li Mei, accepting his award for winning the 2015 Research Day Staff Poster Competition (staff). Right: Allauddin Siddiqi, winner of both the 2015 Research Day Postgraduate Poster Competition and the SJWRI Postgraduate Research Publication Award.

## 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 in the previous calendar year. The recipient receives \$1,000 towards professional development.

### 2015 winner: Associate Professor Brian Monk

Associate Professor Monk is the Director of the SJWRI's Molecular Biosciences Laboratory and a leading figure within the Molecular Microbiology research programme. His research is focused on discovering new ways to combat infectious disease, especially where clinically significant drug resistance has emerged. A key element to this work is identifying new molecular targets for antifungal diseases and characterising their molecular structure, followed by using molecular genetic manipulation of yeast and bacterial systems to express drug targets for screening of compound libraries to find compounds which act against these targets. Many of the antifungal targets he has developed are membrane proteins, including essential P-type ATPases, fungal glucan synthase, cytochrome P450 enzymes and drug efflux pumps. In 2014, Associate Professor Monk published the first structure for a fungal cytochrome p450, the target of widely-used antifungal drugs, and the only full-length structure of a eukaryotic membrane-associated cytochrome p450. The work, a major result of a Marsden Fund grant awarded to Associate Professor Monk in 2011, was published in high-impact journal *Proceedings of the National Academy of Sciences USA*, which has an impact factor of 9.41 and is regarded as one of the leading scientific journals internationally.

Monk, B. C., Tomasiak, T. M., Keniya, M. V., Huschmann, F. U., Tyndall, J. D. A., O'Connell, J. D., III, Cannon, R. D., ... Stroud, R. M. (2014). Architecture of a single membrane spanning cytochrome P450 suggests constraints that orient the catalytic domain relative to a bilayer. *PNAS*, 111(10), 3865-3870. doi: [10.1073/pnas.1324245111](https://doi.org/10.1073/pnas.1324245111)

### 2016 winner: Dr Sunyoung Ma

Dr Ma is a Senior Lecturer in Prosthodontics in the Department of Oral Rehabilitation, with research interests in oral implantology. Her paper, titled 'Maxillary three-implant overdentures opposing mandibular two-implant overdentures: 10-year surgical outcomes of a randomised controlled trial' and published in the June 2016 edition of *Clinical Implant*

*Dentistry and Related Research*, followed long-term surgical outcomes and implant success of implant treatments on edentulous patients over ten years. Dr Ma was the lead investigator of the study and collected the clinical data, along with being primary author of the paper. *Clinical Implant Dentistry and Related Research* has an impact factor of 4.152 and is ranked 4th of 89 journals in the field of Dentistry Oral Surgery and Medicine. This work contributes significantly to further understanding in the area of selecting implant treatment modalities when rehabilitating older edentulous patients.

Ma, S., Tawse-Smith, A., De Silva, R. K., Atieh, M. A., Alsabeeha, N. H. M., & Payne, A. G. T. (2016). Maxillary three-implant overdentures opposing mandibular two-implant overdentures: 10-year surgical outcomes of a randomised controlled trial. *Clinical Implant Dentistry & Related Research*, 18(3), 527-544. doi: [10.1111/cid.12325](https://doi.org/10.1111/cid.12325)

## 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 in the previous calendar year, and have been written by a Masters or Doctoral research student. The recipient receives \$500.

### 2015 winner: Allauddin Siddiqi (PhD student)

Allauddin Siddiqi commenced his PhD in 2009 and graduated in 2014. Allauddin's major research interests are in maxillofacial trauma and implantology. His PhD, titled 'Surgical and peri-implant outcomes of ceramic implants supporting overdentures', was centered around the rehabilitation of edentulous elderly persons, comprising a human clinical trial, an *in vivo* sheep study and *in vitro* human cadaver study. His award-winning paper, 'Analysis of *P. gingivalis*, *T. forsythia* and *S. aureus* levels in edentulous mouths prior to and six months after placement of one-piece zirconia and titanium implants' was accepted for publication in the journal *Clinical Oral Implants Research* (Impact factor 3.123) in November 2014. This journal is ranked 4th of 83 journals in the field of Dentistry Oral Surgery & Medicine. Dr Siddiqi's analyses determined whether the periodontopathic bacteria *Porphyromonas gingivalis* and *Tannerella forsythia*, as well as the non-periodontopathic bacterium *Staphylococcus aureus*, emerged in edentulous patients six months after placement of one-piece zirconia and titanium implants. The results indicated that they did not.

Siddiqi, A., Milne, T., Cullinan, M. P., & Seymour, G. J. (2014). Analysis of *P. gingivalis*, *T. forsythia* and *S. aureus* levels in edentulous mouths prior to and 6 months after placement of one-piece zirconia and titanium implants. *Clinical Oral Implants Research*, 27, 288-294. doi: [10.1111/clr.12536](https://doi.org/10.1111/clr.12536)

## 2016 winner: Alia Sagatova (PhD student)

Alia completed her PhD in the Molecular Microbiology research programme of the SJWRI in 2016, under the primary supervision of Associate Professor Brian Monk. Her thesis research was on the discovery and development of multifunctional triazole drugs. Her award-winning paper, titled 'Structural insights into the binding of the antifungal drug fluconazole to *Saccharomyces cerevisiae* lanosterol 14 $\alpha$ -demethylase' was published in *Antimicrobial Agents & Chemotherapy*, one of the most widely read journals in the field of antifungal research with an impact factor of 4.476 in 2014. Infections by fungal pathogens such as *Candida albicans* and *Aspergillus fumigatus*, and their resistance to triazole drugs, are major concerns. Lanosterol 14 $\alpha$ -demethylase is a fungal enzyme involved in ergosterol biosynthesis, and is the primary target of azole antifungal drugs, including fluconazole. The lack of high-resolution structural information for this enzyme has inhibited the design of modified triazole drugs that could overcome resistance. This paper, one of a series of publications based on Alia's PhD research, reported the X-ray structure of full-length *Saccharomyces cerevisiae* lanosterol 14 $\alpha$ -demethylase in complex with fluconazole at a resolution of 2.05 Å, showing the key interactions involved in fluconazole binding and providing insight into resistance mechanisms. Alia was the lead author on this paper and performed most of the research within it.

Sagatova, A., Keniya, M. V., Wilson, R. K., Monk, B. C., & Tyndall, J. D. A. (2015). Structural insights into the binding of the antifungal drug fluconazole to *Saccharomyces cerevisiae* lanosterol 14 $\alpha$ -demethylase. *Antimicrobial Agents & Chemotherapy* 59:4982-4989. doi: [10.1128/aac.00925-15](https://doi.org/10.1128/aac.00925-15)

## Research Support Award

This award is to recognise the excellent support provided by general staff to research groups, units and/or departments within the SJWRI and Faculty of Dentistry. The recipient receives \$2,000 for professional development.

## 2016 recipient: Sharla Kennedy, Medlab Dental Oral Pathology and Diagnostic Service

Sharla has over 20 years' experience in histology and, for the last eight years since being employed with the Faculty of Dentistry, has taken on the position of research coordinator in the Oral Pathology laboratory. She has responsibility for the histology aspects of the research projects of the Oral Molecular and Immunopathology Programme, and also assists researchers from other research programmes within the Faculty and from outside the Faculty. This involves planning and assisting in research projects that use various techniques including histology, immunohistochemistry and immunofluorescence. As part of the laboratory team, Sharla also offers technical advice to staff and PhD, DClintDent and undergraduate dental students. In addition to her technical support, she has an encouraging and supportive manner, which has been very important to many postgraduate students coming to grips with the complexities of research. Without Sharla's technical and emotional support, many of these research projects would not have come to fruition.



2016 Research Supervisor Award winner Professor Alison Rich, with Lynda Horne of the Medlab Dental Oral Pathology and Diagnostic Service.

## Student awards and achievements

### SJWRI PhD student Jenny McDowell wins University Three Minute Thesis Competition, represents Otago at the Trans-Tasman 3MT Competition

On the evening of Wednesday 26 August, SJWRI PhD student Jenny McDowell won the 2015 University of Otago Three Minute Thesis (3MT) Competition, competing against PhD candidates from across all divisions of the University. Jenny's 3MT presentation 'Identifying missing persons: getting answers from our bones' explored her PhD thesis research, which looks at the chemical and morphological changes which happen in juvenile bone when exposed to a marine environment, as a means of understanding marine decomposition of human body parts in a forensic context.

Jenny's prize for winning the Otago 3MT was a research grant of \$1,000 and a trip to the Trans-Tasman 3MT Competition, held at the University of Queensland on Friday 2 October, where Jenny represented Otago against PhD winners from universities across Australia, New Zealand, Oceania and south-east Asia. Fifty competitors were entered into the competition, divided into five semi-final heats. Two semi-finalists were selected from each heat to compete in the final.

Jenny won through from her semi-final heat to compete in the ten-person final. While she was not successful in winning the competition, making the final (and thus the top ten in Australasia) was a magnificent achievement given the exceedingly high quality of the competitors and presentations.

Jenny's interest in forensic anthropology came from a teenage interest in human anatomy triggered by surviving a shark attack, which led to beginning a PhD in the SJWRI under the mentorship of the late Professor Jules Kieser. Following in Jules' footsteps, Jenny's aim is become a world expert in marine forensics and disaster victim identification, and to be the first in New Zealand to obtain international accreditation in forensic anthropology. In December 2014, Jenny was awarded a AMP National Scholarship worth \$10,000 to support her ambition of becoming an internationally accredited forensic anthropologist.

The overall winner of the Trans-Tasman 3MT Competition was Eamonn Fahy of the University of Melbourne's Centre for Eye Research Australia, with his presentation 'Catching the silent thief of sight.' The People's Choice Award was presented to Jaysuman Bin Pusppanathan of the Faculty of Electrical Engineering, Universiti Teknologi Malaysia, who presented on 'Tomography for liquid gas imaging.'



Three Minute Thesis judge Professor Rachel Spronken-Smith (left) and PhD section winner Jenny McDowell at the competition finals.

## Colgate IADR New Zealand Section Student Poster Competition

Each year, the SJWRI in conjunction with the IADR New Zealand Section holds the Colgate IADR NZ Section Student Poster Competition for undergraduate and postgraduate research students, with award winners supported to attend that year's IADR Australia and New Zealand Division Annual Scientific Meeting and present their research.

### 2015 winners

This year, with the Annual Scientific Meeting to be held in Dunedin in August, four prizes of \$1,000 were kindly made available by Colgate New Zealand, with two further IADR ANZ Division Travel Grants also awarded to help towards meeting expenses such as conference registration and poster printing. Thank you to all this year's competitors and their supervisors.

### Colgate Award Winners

#### Colgate Award, Undergraduate

Danyon Graham

*The molecular basis of triazole inhibition of an antifungal target*

#### Runner-up

Joanne Lee

*Extracellular cysteines of Candida albicans Cdr1p affect its efflux-pump function*

#### Colgate Award, Postgraduate

Avadhoot Avadhani

*Interleukin 17 stimulates invasion in oral squamous cell carcinoma*

#### Runner-up

Mohammed Alansary

*Primary tooth pulp as a source of progenitor cells for permanent pulp tissue regeneration*

### IADR Division Winners

#### IADR ANZ Division Travel Grant, Undergraduate

Joyce Yu

*Effectiveness of dental students' crown preparations using preparation assessment software*

#### IADR ANZ Division Travel Grant, Postgraduate

Sobia Zafar

*Role of osteoclasts in bisphosphonate-related osteonecrosis of the jaw*

Many thanks to judges, Dr Colleen Murray and Dr Geoffrey Tompkins, and competition convenor Associate Professor Nicholas Chandler.

## 2016 Colgate IADR New Zealand Section Student Poster Competition

With the IADR ANZ Annual Scientific Meeting being held in conjunction with the 94th General Session of the IADR in Seoul, South Korea on 22-25 June 2016, two prizes of \$2,000 were made available by Colgate New Zealand and the IADR NZ Section. The following students were selected as having the best poster in their category and were supported to represent New Zealand at the Seoul meeting:

### Colgate Award, Postgraduate

Abdullah Barazanchi

*Comparative study of the physical properties of 3D printing versus powder-metallurgy cobalt chromium*

### Colgate Award, Undergraduate

Chuen Lin Hong

*Growth inhibition of non-streptococcal pathogens by Streptococcus salivarius*

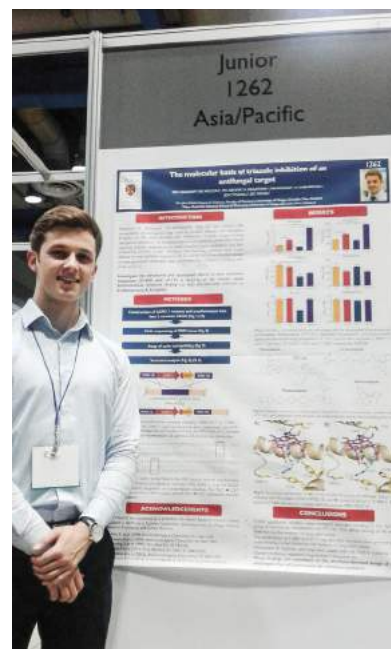
## Dentistry summer students excel at 2016 OMSRS Scientific Meeting

Congratulations to 4th-year BDS student Danyon Graham on winning the summer student presentation prize at the 226th Scientific Meeting of the Otago Medical School Research Society, held on 11 May at the Dunedin Public Hospital.

At this meeting, 2015-16 Division of Health Sciences summer students presented results from their summer studentship projects. Twenty five students submitted abstracts, of which ten were selected for the oral competition.

Two of the students selected for the oral competition were dental students; Danyon (supervised by Associate Professor Brian Monk and his team) and third-year BDS student Annie van Wichen (supervised by Dr Erwin Lamping and Dr Hee Ji Lee).

Congratulations to Danyon and supervisors, and to Annie for the admirable achievement of advancing to the oral presentation round from a strong field.



BDS student Danyon Graham presenting his poster at IADR 2016 in Seoul. Danyon was invited to present his research at the IADR General Session having won the 2015 Colgate IADR NZ poster competition, followed by the Junior Division of the Colgate Poster Competition at IADR ANZ 2015.



# Research funding successes

## Health Research Council

### Tracing oral health from childhood to mid-life: 2015 HRC funding success for Dr Jonathan Broadbent

Dr Jonathan Broadbent of the SJWRI's Dental Epidemiology and Public Health research programme was announced in June 2015 as the recipient of a \$1.2 million, five-year research grant in the Health Research Council of New Zealand's annual funding round. Dr Broadbent, a Senior Lecturer in the Department of Oral Rehabilitation, is Principal Investigator on the project, titled 'Oral health from childhood to mid-life'.

The study is centred around the age-45 oral health assessments of the Dunedin Multidisciplinary Health and Development Study, popularly known as the Dunedin Study, one of the longest-running and most successful longitudinal health studies in the world. The Dunedin Study follows the health life course of a cohort of people born in Dunedin in 1973-74. One of the most remarkable features of the Dunedin Study is its very high subject retention rate (95% in the most recent age-38 assessment, 2010-2012).

The 'Life-course research in oral health' component of the Dunedin Study looks into the natural history of oral health and disease in the Dunedin Study cohort. Through its many years of operation, this study has provided unprecedented information on the natural history of oral health and disease. Poor oral health is a global health problem, which disproportionately affects disadvantaged people. However, there is a lack of high quality information about oral health during the mid-part of the life course, particularly about how experiences and disadvantage during childhood shape the oral health of adults.

This study will inform investigations into the rate of dental health decline into the fifth decade of life, and the mediators, moderators and comorbidities that are associated with good or poor oral health into the fifth decade. Dr Broadbent's co-investigators on this project include Professor Murray Thomson, Director of the Dental Epidemiology and Public Health research programme, and Professor Richie Poulton, Director of the Dunedin Study.

Dr Broadbent's broader research includes projects involving the epidemiology of dental caries, tooth loss, and periodontal disease (with emphasis upon longitudinal research), and particularly upon social inequalities that exist in oral health. He also carries out research on the New Zealand dental workforce. Dr Broadbent collaborates in a number of interdisciplinary projects with researchers in New Zealand and overseas; in recognition for the quality of his cross-disciplinary dental/psychology research,

Dr Broadbent was awarded a NIDCR 'Building Bridges award' at a 2014 conference of the Association for Psychological Science (USA).

In the 2015 HRC round, University of Otago researchers were awarded nearly \$32 million in new funding to support world-class research aimed at improving the health and well-being of New Zealanders. Otago researchers gained 18 contracts, including three major multi-million, five-year programmes and 15 projects.



Dr Jonathan Broadbent presenting at Research Day 2014.

### Overcoming antifungal drug resistance: 2016 HRC success for A/ Prof Brian Monk

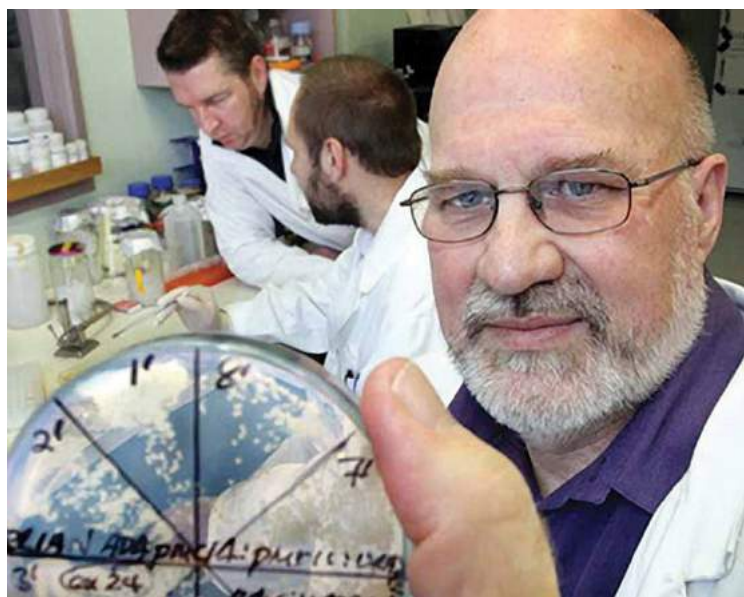
Congratulations to Associate Professor Brian Monk of the SJWRI's Molecular Microbiology research programme on being awarded a three-year Project grant worth \$1,197,552 in the 2016 Health Research Council of New Zealand Funding Round for his project 'Structure-directed discovery of next-generation antifungals'. Other named investigators from the SJWRI involved in this project are Dr Mikhail Keniya and Dr Rajni Wilson, along with Associate Professor Joel Tyndall of the School of Pharmacy.

The aim of this research is to identify and develop next-generation antifungals to augment existing triazole drug treatments that are prone to drug resistance by infectious fungal microbes. This project follows on from an earlier study funded in the 2013 HRC round, which investigated the structure of a key fungal metabolic enzyme lanosterol 14 $\alpha$ -demethylase (CYP51).

CYP51 catalyses the key step in the ergosterol biosynthetic pathway targeted by triazole antifungal drugs. Through this work, the team have obtained high-resolution X-ray crystal structures of wild type and triazole resistant CYP51s, complexed with substrates and triazole inhibitors.

This project will apply these structural discoveries to improve drug specificity, by modifying several features of existing antifungals to develop broad-spectrum drugs that can target fungal CYP51 and not its human homologue or other key metabolic enzymes. The identification of new antifungals will provide a model for drug discovery and development that circumvents the ubiquitous activities of cytochrome P450 enzymes.

Associate Professor Monk's project was one of 17 Otago projects funded in the 2016 HRC round, in addition to five major, multi-million dollar, five-year programmes including renewal of the Dunedin Study for its age-45 assessments. Funding for the dental component of the age-45 Dunedin Study assessments, led by the SJWRI's Dr Jonathan Broadbent, was secured in the 2015 HRC Funding Round. In total, University of Otago researchers were awarded around \$43.8M in new health research funding to support world-class studies aimed at improving New Zealanders' health and well-being.



Associate Professor Brian Monk (foreground), Associate Professor Joel Tyndall and Dr Mikhail Keniya (background).

## Ministry of Business, Innovation and Employment funding

### UltraD3 team awarded \$1.2M in 2015 MBIE funding to develop new dental diagnostics

Professor Warwick Duncan of the SJWRI and collaborator Paul Harris of Callaghan Innovation were today awarded \$1.2 million in MBIE Targeted Research funding over three years for a project called UltraD3, the aim of which is to develop new dental diagnostic devices which can detect disease using ultrasound.

The UltraD3 project aims to develop a miniaturised ultrasonic device for the early diagnosis of periodontal (gum) disease around teeth and dental implants. Periodontal disease is a common condition; severe periodontitis is the sixth most prevalent condition in the world, and one in three New Zealand adults have evidence of periodontal pockets. There is a strong link between periodontal infection and other diseases with high mortality and morbidity, including cardiovascular disease, stroke, diabetes, and adverse pregnancy outcomes. Examination techniques for periodontal disease have not changed in a century, involving painful manual probing of the gums around teeth to determine whether the gum tissue is inflamed or diseased.

The UltraD3 concept employs miniaturised high frequency transducers and imaging systems and applies these to the clinical problem of diagnosing early inflammation around teeth and dental implants. By using ultrasonics to examine changes in the elasticity of the gum tissue (gingiva) and ligaments that connect the tooth to the surrounding tissues, the team aims to provide an early diagnosis of periodontal disease. Earlier intervention for gum problems will reduce both the discomfort and the cost of late-stage surgical treatment for these conditions. Between the SJWRI and Callaghan Innovation, the UltraD3 team has world-leading capabilities in dental research, ultrasonics, electronics and materials science.

The SJWRI congratulates Professor Duncan and the UltraD3 team on this tremendous news.

## SJWRI collaborator wins national award

Dr Carla Meledandri won the 2016 Emerging Innovator Award at the KiwiNet Research Commercialisation Awards for her work harnessing silver nanoparticles to treat and prevent dental disease, carried out in collaboration with Dr Don Schwass.

Dr Meledandri was announced as joint winner of the Norman F. B. Barry Foundation Emerging Innovator Award with the University of Canterbury's Dr Daniel Holland, whose work focuses on mathematics plus measurements equals economic benefit.

"In my case, working toward this goal has required a great team effort over the last several years."

Dr Meledandri feels proud to have been able to contribute to a celebration of Kiwi innovation, saying: "The process involved in the translation of academic research into commercial outcomes is not always an easy one, and in my case, working toward this goal has required a great team effort over the last several years."

"I am delighted to have received recognition for our success so far."

The Department of Chemistry's Professor Lyall Hanton says Dr Meledandri's success is testament to the innovative multidisciplinary work she has done with her group and colleagues in the SJWRI.

The awards are designed to celebrate commercialisation success in New Zealand's universities and Crown Research Institutes, and were announced at a reception in Auckland.

The Kiwi Innovation Network (KiwiNet) [kiwinet.org.nz](http://kiwinet.org.nz) is a consortium of 16 universities, Crown Research Institutes and a Crown Entity established to boost commercial outcomes from publicly funded research. Principal support is also provided by the Ministry of Business, Innovation & Employment.

## SJWRI-led 'Silverbone' innovation supported by 2016 MBIE Endeavour Fund

An innovative new approach to developing bone grafting material with anti-bacterial qualities has been supported by the New Zealand Ministry of Business, Innovation and Employment (MBIE) in their 2016 Endeavour Round. The 'Silverbone' approach, led by SJWRI Clinical and Translational Research programme leader Professor Warwick Duncan, combines the university's unique 'nano-silver' technology with New Zealand-developed bone grafting materials to produce artificial bone grafting materials that are resistant to bacterial infection. Professor Duncan and colleagues were awarded \$999,804 over three years, with the eventual aim of developing Silverbone products that will encourage bone growth and repair in patients undergoing orthopaedic or oral surgical treatment.

"The project combines clever nanoscience, a detailed understanding of biomaterials, a great local company that has been producing world-class bone grafting products for many years, and specialist dental practitioners who want better products for their patients," says Professor Duncan, who in addition to working as an academic and researcher also runs a private specialist practice. "I routinely use bone grafting products to reconstruct people's jawbones following gum disease, after tooth extraction or when placing dental implants. Unfortunately our mouths are quite dirty places, and sometimes these grafts get infected, which can be both painful, disfiguring and expensive for my patients. Our plan is to develop a locally-produced grafting product that is resistant to infection and hopefully cheaper than equivalent products bought from overseas."

Professor Duncan leads a collaborative team involving Dr Carla Meledandri from the University of Otago Department of Chemistry, Associate Professor Neil Waddell and Dr Mike Smith from the SJWRI and Faculty of Dentistry, and Dr Nina Molteno from Molteno Ophthalmic Ltd, a specialist Dunedin company who are leaders in the development and manufacture of ophthalmic implants for treating glaucoma and other eye conditions.

"We are grateful to MBIE for supporting this initiative, which we think is good for science, good for Kiwis needing dental treatment, and good for New Zealand business," says Professor Duncan.

The purpose of MBIE's Endeavour Fund is to invest in excellent research that is designed to have a positive impact for New Zealand economically, environmentally and socially. The Endeavour Fund supports both Smart Ideas initiatives and larger Research Programmes. Smart Ideas initiatives, such as the SJWRI's Silverbone proposal, catalyse and rapidly test promising, innovative research ideas.

## SJWRI-Chemistry collaboration leads to dental caries prevention breakthrough

A collaboration between researchers in the University of Otago's Department of Chemistry and the SJWRI has led to a new way to preserve caries-infected teeth and prolong the life of dental fillings being developed and commercialized through Otago Innovation Ltd.

The technology uses specially-formulated, non-staining silver nanoparticles to arrest caries and make teeth more resistant to decay. The dentist applies the product after removing decay but before filling, and it diffuses into the tooth where it can kill any remaining bacteria that may cause further decay.

The Otago invention is unique because it does not discolour the teeth. All other available products that use silver to arrest caries turn teeth black, and therefore, they have not been widely accepted by patients or dental practitioners.

"We believe that our non-staining formula will be an important step forward for oral care and public health," says Dr Don Schwass of the Department of Oral Rehabilitation. "The result will be that recurrent caries will be significantly reduced and dental fillings will last longer, providing both economic and health benefits."

"Our contribution has been to create stabilised nanoparticles of a certain size, using a unique method of production so that the end result is a clear, stain-free product," says Dr Carla Meledandri of the Department of Chemistry and the MacDiarmid Institute.

Otago Innovation Ltd has recently licensed the rights to this invention to a global dental materials manufacturer for further product development.

## SJWRI makes a good impression with Unlocking Curious Minds outreach project

A new SJWRI-led outreach project, supported by the government's Unlocking Curious Minds initiative, is using a hands-on activity - making impressions of animal teeth - to introduce children to the science of everyday life. The project, titled 'Making a good impression: from fossils to false teeth' was one of 44 projects supported for funding in the 2016 Unlocking Curious Minds investment round, announced by the Minister of Science and Innovation last week.

Led by research fellow Dr Carolina Loch and SJWRI Director Professor Richard Cannon, Making a good impression: from fossils to false teeth aims to engage with students from lower-decile primary schools in Dunedin in order to unlock their curiosity about the science behind fossils, animal teeth and tooth function, and also raise their awareness of oral health. Children from lower decile schools tend to have fewer opportunities for hands-on science activities than pupils from high decile schools, as well as experiencing poorer oral health.

The activity will involve the students taking impressions of teeth from various marine and terrestrial animals, including taonga species, to make replicas that they can keep. Accompanying videos, which are available on the SJWRI website, explain the science behind fossil formation, dental impression taking, tooth shape and function, and the importance of looking after your teeth for good oral and general health.

The hands-on part of the 'Making a good impression project' was first trialled as part of the highly successful UCM-supported 'Family Science and Technology Experience' sessions organised by the Otago Museum and between October 2015 and February 2016, at schools around Dunedin, and further developed it as part of the Otago Museum's Oral Health Open Day in March of this year. In each case, Carolina and Richard were very encouraged by the strong interest and engagement they saw with children and their parents in the activity and the educational messages associated with it.

Funding from the Unlocking Curious Minds initiative will support further development of the hands-on activity and the associated videos, and taking the activities to schools around the Dunedin area.

If successful, the team hopes to extend the pilot outreach regionally, potentially in partnership with the University of Otago's Lab In A Box project, also supported by Unlocking Curious Minds.



Dr Carolina Loch and children from Carisbrook School at a 'Family Science and Technology Experience' event in October 2015.

## Further evidence found against ancient “killer walrus” theory

An Otago-led team of scientists using techniques from the field of dentistry is shedding new light on the evolution of walruses, fur seals and sea lions. The researchers have cast further doubt on previous claims that an ancient “killer walrus” was a marine mammal eater.

In a newly published article in the international journal, *The Science of Nature*, the multidisciplinary team of researchers report their analysis of the internal structure of tooth enamel in a fossil walrus from California, *Pelagiarctos thomasi*, and in teeth of modern pinnipeds the New Zealand fur seal and sea lion.

Study co-author Dr Carolina Loch of the SJWRI says this was the first time the enamel ultrastructure of fur seals and sea lions, as well as the extinct walrus *Pelagiarctos*, was studied using scanning electron microscopy.

“*Pelagiarctos* was originally thought to have been a “killer walrus” that fed on large prey such as other marine mammals, but we found it has an enamel layer reasonably similar to that of modern New Zealand fur seals and sea lions, which are fish and squid eaters,” Dr Loch says.

“The enamel structure the researchers identified in *Pelagiarctos* meant the walrus was unlikely to be up to crunching through large bones without cracking its teeth – suggesting that it was a dietary generalist like the modern New Zealand pinnipeds studied,” she says.

Dr Loch says the study showed how using techniques and methods commonly employed in dentistry can answer questions with broader implications in the biology and evolution of animal species.

“Features and structures of the enamel layer have long been associated with differences in diet and tooth usage among animals, and can also help in the understanding the relationships among fossil and living species.

“Teeth are not only the focus of modern dentistry, but also valuable tools for biologists, archaeologists and palaeontologists,” Dr Loch says.

The study was conducted by Dr Loch, research fellow at the SJWRI (and Otago alumna – Department of Geology and Faculty of Dentistry); Dr Robert Boessenecker, College of Charleston USA (and Otago alumni – Department of Geology); Dr Morgan Churchill (New York Institute of Technology College of Osteopathic Medicine, USA) and the late Professor Jules Kieser (Otago Faculty of Dentistry) – who is always remembered for his prolific multidisciplinary dental research.

A 2013 paper by Drs Boessenecker and Churchill was the first to cast doubt on the “killer walrus” claims and the latest findings bolster their case, Dr Loch says.

## New Zealand Dental Association Research Foundation and Ministry of Health Oral Health Research Fund strong supporters of SJWRI research in 2015 and 2016 grant rounds

SJWRI research staff and students have been highly successful in the NZ Dental Association Research Foundation and Ministry of Health Oral Health Research funding rounds in 2015 and 2016. In total, some \$420,103 was awarded to SJWRI-led projects in the 2015-16 period across both of these NZDA-administered research funds.

Established in 1964, the NZ Dental Association 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 NZDA Research Foundation 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 2015, our researchers were primary investigators or co-investigators on ten research proposals awarded \$122,712 in funding from the NZDA Research Foundation. In 2016, our researchers were primary investigators on eleven research proposals awarded \$107,600 in funding from the NZDA RF. Many of these awards supported the research of postgraduate students and the training of specialist dentists.

## New Zealand Dental Association Research Foundation

Our funding recipients in the 2015 round were:

Principal applicant	Other applicants (SJWRI unless noted)	Project title	Awarded
Dr Joseph Antoun	Prof Mauro Farella, <i>Azza Al-Ani</i> , Prof Tony Merriman (Biochemistry), Prof Murray Thomson	Finding the missing link for hypodontia	\$10,243
<i>Joanne Choi</i>	Prof Mauro Farella, Prof Karl Lyons, Assoc Prof Neil Waddell	Continuous measurement of intraoral pH and temperature of individuals with and without xerostomia	\$5,500
Dr Dawn Coates	Prof Richard Cannon, Dr Trudy Milne, Prof Alison Rich	An ABI qPCR machine for oral health research	\$15,000
<i>Fiona Firth</i>	Dr Benedict Seo, Dr Trudy Milne, Prof Mauro Farella	The effect of mechanical strain on the unfolded protein response of periodontal ligament cells in a three-dimensional culture	\$15,000
Dr Lara Friedlander	<i>Hitesh Navani</i> , Prof Alison Rich, Dr Trudy Milne, Peter Cathro	Angiogenesis in the apical papilla of immature permanent teeth associated with healthy and inflamed dental pulps	\$14,990
Suzanne Hanlin	Dr Sunyoung Ma, Dr Lara Friedlander	A 5-year retrospective assay (audit) of the outcomes of implant therapy in New Zealand private dental practice	\$13,000*
Dr Haizal Hussaini	Alison Rich, <i>Adil Alkharusi</i>	Expression of STAT 3 and cytokines (IL22, IL23, TH17) within metastatic lymph nodes of oral squamous cell carcinoma (OSCC)	\$12,134
Assoc Prof Neil Waddell	Prof David Prior (Geology), Kai Chun Li, Dr Carla Meledandri (Chemistry), Dr Karl Lyons	Gold nanoparticle reinforcement of biomedical dental ceramics	\$12,000
Dr Matthew Woods		Precision balance and pH meter for dental research including drug discovery	\$9,845
<i>Muhammed Yakini</i>	Dr Benedict Seo, Prof Alison Rich	Oral cancer cells under stress: The intertwined roles of cell stress and the dynamic signalling pathways	\$15,000

Names italicised above are SJWRI postgraduate students (either PhD or DClinDent). \* Grant-in aid.

Our funding recipients in the 2016 round were:

Principal applicant	Other applicants (SJWRI unless noted)	Project title	Awarded
<i>Nawal Radhiah Abdul Rahman</i>	Dr Benedict Seo, Dr Haizal Hussaini, Prof Alison Rich	Expression of the lysyl oxidase family in benign odontogenic tumours	\$9,442
Dr Jonathan Broadbent	Prof Murray Thomson	A life course study on chronic dental conditions and ageing of the teeth and dentition: equipment grant	\$13,500
<i>Sy Yin (Adeline) Chai</i>	Assoc Prof Vincent Bennani, John Aarts, Prof Karl Lyons, Dr Bronwyn Lowe, Andrew Gray	The effect of preparation design on stress distribution and fracture strength of porcelain laminate veneers	\$6,500
Prof Mauro Farella	Dr Joseph Antoun, Assoc Prof Nicholas Chandler, Prof Tony Merriman (Biochemistry), <i>Will Sew Hoy</i>	Genetic and psychological factors associated with orthodontic pain in children and adolescents	\$8,441
Prof Mauro Farella	<i>Divya Ramanan</i> , Dr Ajith Polonowita, Dr John Hamilton, Prof Sandro Palla (U Zurich)	Jaw muscle overload as a possible cause of orofacial pain and headache	\$12,350
<i>Nurul Ruziantee Ibrahim</i>	Dr Haizal Hussaini, Dr Benedict Seo, Prof Alison Rich	Lymphangiogenesis in metastatic lymph nodes of oral squamous cell carcinoma	\$10,800
<i>Ludwig Jansen van Vuuren</i>	Prof Warwick Duncan, Assoc Prof Neil Waddell	Development of a simulant model for clinically relevant testing of implant-and natural tooth-supported all-ceramic restorations	\$8,000*
Jae-Kwang Jung	Dr Haizal Hussaini, Dr Benedict Seo, Prof Alison Rich	Investigation of the role of lymphangiogenesis in oral lichen planus	\$12,144
Dr Venkata Praveen Parachuru	Prof Warwick Duncan, Dr Ellie Knight	IL33 and IL35 expression in healthy and diseased gingival tissues	\$14,988
<i>Elizabeth Williams</i>	Dr Benedict Seo, Dr Haizal Hussaini, Dr Dawn Coates, Prof Alison Rich	Investigation of the presence of human papillomavirus in verrucal-papillary lesions of the oral cavity and comparison of viral detection methods	\$8,962
<i>Muhammed Yakin</i>	Dr Benedict Seo, Prof Alison Rich	The expression of STAT3 signalling pathway proteins in Oral Squamous Cell Carcinoma tissue	\$2,503

*Names italicised above are SJWRI postgraduate students (either PhD or DClinDent).*

*\*Grant-in aid of \$3,000 from the NZDARF and \$5,000 from the International College of Dentists*

## Ministry of Health Oral Health Research Grants

In 2007, the New Zealand 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., Māori, 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.

Four SJWRI-led projects totalling \$62,247 were funded from the Ministry's targeted Oral Health Research fund in 2015, with another five projects totalling \$119,544 supported from the OHR fund in 2016.

Our successful applicants in the 2015 round were:

Principal applicant	Other applicants	Project title	Awarded
<i>Leonard Chia</i>	Prof Darryl Tong, Assoc Prof Lyndie Foster Page, Prof Murray Thomson	Clinicians' perspectives on Special Needs Dentistry in New Zealand	\$2,000*
Dr Haizal Hussaini	<i>Hina Narayan</i> , Dr Trudy Milne, Prof Alison Rich	Effect of cigarette smoking on TGF- $\beta$ expression in oral tissues and cells	\$10,517
Haizal Hussaini	<i>Hina Narayan</i> , Dr Trudy Milne, Prof Alison Rich	<i>In vitro</i> effect of cigarette smoke on DNA methylation in oral epithelial cells	\$15,489
Dr Moira Smith (Public Health, UO Wellington)	Prof Murray Thomson	Exploring oral health care planning and service delivery models for dependent older adults in aged residential care facilities: feasibility and acceptability in the aged-care sector	\$34,241

*Names italicised above are SJWRI postgraduate students (either PhD or DClintDent). \* Grant-in aid.*

Our successful applicants in the 2016 round were:

Principal applicant	Other applicants	Project title	Awarded
Assoc Prof Lyndie Foster Page	Dr Joseph Antoun, Dr Hannah Jack	Reading between the lines: how do young New Zealanders from low socio- economic backgrounds feel about not getting their teeth straightened?	\$29,168
Dr Lara Friedlander	<i>Shaikra Al Samahi</i> , Prof Alison Rich, Dr Haizal Hussaini, Dr Trudy Milne	Type 2 Diabetes and inflammatory markers in dental pulp	\$14,891
Prof Alison Rich	<i>Dema Waleed</i> , Prof Murray Thomson	Teeth for all for life: time to rethink? Comparing retaining natural teeth versus dentures among New Zealand's older population	\$1,620
Dr Lee Smith	Assoc Prof Lyndie Foster Page, Dr Rosalina Richards (Preventive& Social Medicine)	Pasifika adolescents' understandings and experiences of oral health care	\$36,076
Prof Murray Thomson	Dr Moira Smith (UO Wellington), Prof Ngaire Kerse (U Auckland), Dr Anna Ferguson	Cognitive function, dependency and oral health among frail older New Zealanders: a national survey	\$37,789

*Names italicised above are SJWRI postgraduate students (either PhD or DClintDent).*

The SJWRI and the Faculty are hugely grateful for the role and contribution of the NZDA Research Foundation and the Ministry of Health Oral Health Research Fund 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.



## SJWRI researchers supported by Lottery Health Research equipment grants

SJWRI researchers gained over \$209,000 in funding in 2015-16 from the Lottery Grants Board for equipment to support research aimed at improving the health of New Zealanders.

In 2015, Professor Mauro Farella and colleagues from the Craniofacial Biology and Clinical Oral Physiology research programme were awarded \$90,000 towards the purchase of a 3dMDtrio Imaging System and software, while Wendy-Ann Jansen van Vuuren of Biomechanics and Oral Implantology was awarded \$15,417 towards a Proto-Tech Thermocycler Unit.

The 3dMDtrio system is a portable, ultra-fast, high-precision surface imaging device consisting of nine medical grade cameras and a synchronised flash system, which is designed to capture detailed 3D images of the face at very high resolution. Prof Farella and his colleagues plan to use the 3dMDtrio imaging system to investigate facial deformities such as cleft lip and palate, evaluate treatment outcomes following orthodontics or corrective jaw surgery, and assess new and innovative treatments such as 3D printing of facial prosthetics in head and neck cancer patients. As well as clinical applications, this technology is well suited for investigating the genetic basis of face and jaw abnormalities.

The Proto-Tech Thermocycler Unit will be used in Biomaterials research to simulate temperature changes to which dental restorations are subjected in the oral cavity. The breakdown of dental restorations in the mouth can be aggravated by thermal changes, induced by routine eating, drinking and breathing. By subjecting prototype restorations and other biomaterials to temperature fluctuations, accelerated aging experiments can be conducted to reveal possible weaknesses. This will aid in the development of improved dental materials with higher fracture toughness and wear resistance.

In 2016, Associate Professor Brian Monk, Director of the Molecular Bioscience Laboratory (MBL) of the SJWRI led a successful equipment grant application to Lottery Health Research for the purchase of an AKTA™ PURE 25 FPLC system (\$109,133).

The AKTA™ PURE 25 FPLC system is an advanced chromatography system for protein fractionation and purification which is used on a daily basis by numerous ongoing and future research projects in the MBL. Modern research in the fields of oral health, dentistry and medicine often requires detailed information


about particular proteins in order to translate the basic biology into health benefits. The ability to isolate and determine the structure and function of individual proteins is fundamental to molecular and microbiological research. The AKTA™ PURE 25 FPLC system enables more sophisticated and efficient study of proteins by integrating with the MBL's expertise in molecular biology, its facilities for cell, microbial culture, centrifugation plus a library of centrifuge heads. It is used in a wide range of analytical studies related to dentistry, provide understanding basic biological phenomena at the molecular level, and aids in the determination of drug target structures needed to facilitate structure-directed drug discovery designed to circumvent drug resistance. The FPLC system will also be made available to other researchers in the Dunedin campus of the University of Otago.

## Popular Forensic Biology summer school course continues as Prof Jules Kieser's legacy

Increasingly, forensic investigations have come to rest on the techniques of forensic biology to provide vital evidence in homicides, violent crimes, disaster identification and even minor crimes. These techniques are also commonly used in a wide range of professional areas such as the investigation of crimes against humanity, forensic archaeology and wildlife protection.

For many years, the SJWRI has leveraged its established strengths in forensic research to run an introductory course in forensic biology, FORB201, at the University's Summer School. FORB 201 was established by the late Professor Jules Kieser (1950-2014), founding Director of the Sir John Walsh Research Institute, who developed the course as an introduction for the student who is interested in analysing biological evidence as it relates to legal and other investigations, or collecting and processing evidence at a crime scene or in a laboratory.

Jules, who passed suddenly in June 2014, was a dynamic academic who made outstanding contributions to teaching and research at the University of Otago and to forensic services in New Zealand and abroad. Several students were inspired by FORB201 course to pursue postgraduate forensic biology research under Jules' supervision. Jules was a valuable member of the Dunedin forensic odontology team. In addition to assisting local police with forensic investigations he received commendations for his contribution to disaster victim identification after the Boxing Day tsunami in 2004 and the Christchurch earthquake in 2011.



The SJWRI has been proud to carry on a small part of Jules' legacy by continuing to run FORB201. The course is coordinated by Dr Angela Clark and Professor Richard Cannon, and taught by Dr Clark in concert with guest lectures from New Zealand and overseas. FORB201 has for many years been one of the most popular summer school courses run by the University, and this has continued under Dr Clark and Professor Cannon's stewardship. A feature of the course is that students have an unequalled opportunity to interact with a range of National and International forensic experts. The multidisciplinary nature of forensics depends on the integration of scientific skills within a forensic context, and hence the course includes a wide spectrum of topics, including trace and contact evidence, DNA, body fluids, traumatology, forensic entomology, toxicology and fibre analysis.

### Mouth breathing while sleeping may increase tooth decay risk

Mouth breathing during sleep is linked to a more acidic oral environment that may promote tooth enamel erosion and caries, new University of Otago research suggests.

Dentistry researchers from the University's Sir John Walsh Research Institute studied the oral pH levels of 10 healthy volunteers who alternated between sleeping with and without a nose clip that forced them to breathe through their mouths.

Their study's findings, published in the *Journal of Oral Rehabilitation* in 2015, showed that the average pH during sleep with forced mouth breathing was a mildly acidic 6.6 compared to a neutral 7 when nose breathing.

Study lead author and PhD student Joanne Choi says the research team found a noticeable difference in the pattern of variation of pH and temperature between day and night.

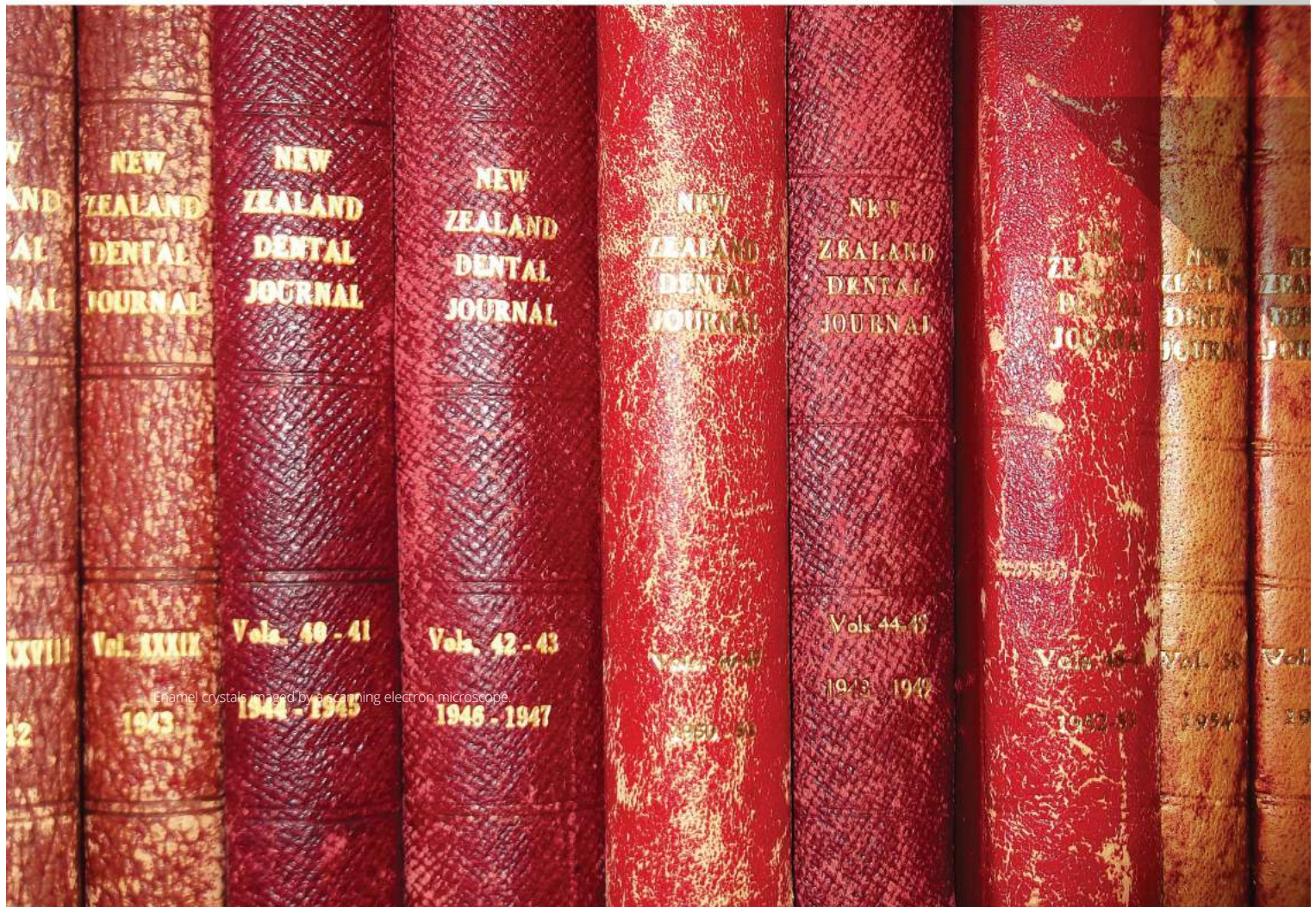
"Intraoral pH decreased slowly over the hours of sleep in all participants, but showed greater falls over a longer period of time when participants were forced to mouth breathe," Ms Choi says.

At times the pH levels fell as low as 3.6 during forced mouth breathing during sleep, well below the critical threshold of 5.5 when enamel starts to demineralise, she says.

"This study is the first to continuously monitor intraoral pH changes in healthy individuals over several days. Our findings support the idea that mouth breathing may indeed be a causal factor for dental diseases such as enamel erosion and caries."

The study, which was funded by the Dentsply Research Foundation and Maurice and Phyllis Paykel Trust project grants, was picked up by media in New Zealand and around the world.

# Research Programmes



Enamel crystals imaged by a scanning electron microscope

# Biomechanics and Oral Implantology

Programme Directors – Associate Professor Neil Waddell and Professor Warwick Duncan

Our work has two main themes, biomechanics and oral implantology. Within the area of biomechanics we conduct experimental and observational research in:

- Dental materials – development of new dental restorative materials for dental CAD/CAM systems.
- Silver and gold nanomaterial technology group – developing nanoparticles for use in a range of therapeutic technologies and toughening of advanced ceramics.
- 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 – using animal teeth to gather a wide range of information about 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.
- Communication of forensic concepts to the general public

Within the area of oral implantology our research focuses on:

- Bone replacement grafting
- Stem-cell regenerative therapies.
- Early diagnosis and treatment of peri-implant immune-inflammatory disease
- Fit of aftermarket versus original equipment manufacturer (OEM) implant components
- Modifications to dental implant materials and surfaces to enhance osseointegration.
- The effects of implant fixture corrosion products on periodontal structures.
- *In vitro* modelling of masticatory forces on implant overdentures, their supporting sub-structures and surrounding bone.
- The short-term and long-term clinical outcomes of modified surgical and prosthodontic loading protocols during implant treatment.

## Key personnel and collaborations

### Staff

Professor WJ Duncan  
Professor KM Lyons  
Professor P Brunton  
Associate Professor JN Waddell  
Professor DC Tong  
Dr P Cathro  
Dr DR Schwass  
Associate Professor A Tawse-Smith  
Dr S Ma  
Ms S Hanlin  
Dr C Loch Santos Da Silva  
Dr KC Li  
Mr L Jansen van Vuuren  
Mrs. W Jansen van Vuuren  
Ms J Choi

### Postgraduate students

Andrew Tawse-Smith	Vanda Symon
Donald Schwass	Seung David Ko
Joanne Choi	Leonid Khimovich
Mohammed Alrashed	James Dawson
Sunyoung Ma	Yevgeny Sheftel
Therese De Castro	Frances Ruddiman
Ludwig Jansen van Vuuren	Allauddin Siddiqi
Veivakatorocaketaki Masi Ovini	Gemma Cotton
Abdullah Barazanchi	Anne-Christine (Anki)
Lisa Falland	Lindstrom

Our work involves a multi-disciplinary approach and we collaborate with a wide group of researchers within; the Faculty of Dentistry; the University of Otago (Department of Geology, Department of Chemistry, Department of Anatomy and Structural Biology, Department of Zoology, Department of Marine Sciences); nationally (Department of Mechanical Engineering, University of Canterbury, Van Der Veer Institute, University of Canterbury, Department of Engineering Sciences, Auckland University, Forensic Science Department of Environmental Science and Research, South Island Brain Injury Research Group (SIBIRG)) and internationally (University of Adelaide School of Dentistry, 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).

## 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 and toughening of high strength ceramics.

**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 Association 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?

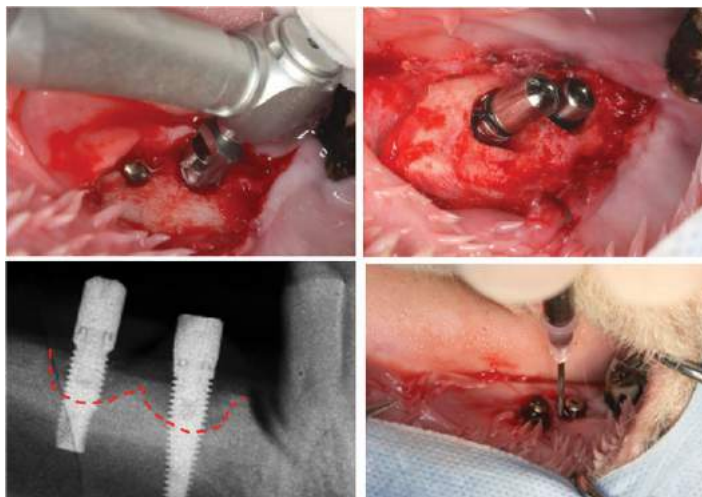
**Source(s) of funding:** Neurological Foundation Research Grant, Maurice and Phyllis Paykel Trust, University of Otago Research Grant. University of Otago Health Sciences Division Sandpit Funding Grant. ANZAOMS Research and Education Trust.

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

**Description:** Investigating the basic properties of skin, teeth and bone related to the craniofacial region and forensic issues.

**Aims:** Teeth and bone are special in that 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. This knowledge can then be linked to clinical findings that will (hopefully) result in better therapeutic outcomes. Our research has mainly been focused on the structure and function of enamel 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 Association Research Foundation, United States Department of Justice, ESR Capability Development Fund.



Nanosilver gel treatment of ligature-induced peri-implantitis in a sheep model (W Duncan, A Siddiqi, D Schwass, C Meledandri, G Cotton, C da Silva).



Biomet 3i Implant in sheep femur model with Endobon bone replacement graft & Osseoguard collagen membrane

Biomet 3i implant in sheep femur model with Endobon bone replacement xenograft and Osseoguard resorbable collagen membrane (W Duncan, P Schmidlin, J Liu).

#### 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 into supporting biological and regenerative products. Our research encompasses immediate placement and/or loading of single implants and implant-supported overdentures, fit of zirconia prostheses, implant analysis using micro-CT, *in vitro* modelling of strain distribution within implant overdentures and their supporting substructures and bone, and *ex vivo* analysis of implant fixture corrosion. Commercially-sponsored research ranges from comparisons of different implant systems, to different bone replacement grafts and resorbable membranes in sheep animal models including mandibular tooth extraction sockets, femur epicondyle and maxillary sinus. We have also recently established a new animal model of peri-implantitis for investigating novel therapeutic agents.

**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. Diagnosis and treatment of peri-implant immunoinflammatory disease.

**Source(s) of funding:** New Zealand Dental Association Research Foundation; JF Fuller Foundation; International Team for Oral Implantology ITI Switzerland; Straumann AG, Switzerland; Nobel Biocare Australia; Southern Implants, South Africa; Otago Innovation Ltd; Zimmer Biomet 3i Ltd, United States of America; Resorba GmbH, Germany; Geistlich Pharma Ltd, Switzerland; Ministry of Business, Innovation and Employment, New Zealand; Maurice and Phyllis Paykel Trust; University of Otago Research Grants.

#### Research funding (over \$5000)

\$12,000 Waddell JN, Falland L, Tong D & Brunton P. Neurological Foundation Research Grant 1624-SPG, Development of skin/skull/brain model to measure impact forces to the head and brain-injury mechanisms.

\$999,804 Duncan WJ, CI – Smith M, Meledandri C and Waddell JN. MBIE's 2016 Endeavour Round – Smart Ideas. "Silverbone" - Otago's nano-silver technology plus NZ-manufactured bone graft produces unique antibacterial biomaterial.

\$8,000 Jansen van Vuuren L, CI – Duncan WJ & Waddell JN. New Zealand Dental Association Research Fund. Development of a simulant model for clinically relevant testing of implant and natural tooth supported all-ceramic restorations.

\$30,026 Loch C & Cannon R, CI – Waddell JN & Brunton P. MBIE, 2016 Unlocking Curious Minds Fund – Local.

\$1,200,000 Duncan WJ and Harris P, CI – Chandler NP and Waddell JN. UltraD3: Ultrasonic Dental Diagnostic Device, MBIE Targeted Research Grant.

\$5,000 Choi J, Waddell JN & Lyons K. New Zealand Dental Association Research Fund. Continuous measurement of intraoral pH and temperature of individuals with and without xerostomia.

\$7000 Waddell JN, Falland L, Tong D & Brunton P. Maurice and Phyllis Paykel Trust, Development of a skin/skull/brain model to measure impact forces to the head and brain injury mechanisms.

\$12,000 Waddell JN, Li KC, Meledandri C, Prior D & Lyons K. New Zealand Dental Association Research Fund. Gold nanoparticle reinforcement of biomedical dental ceramics.

\$35,591 Tong DC, Waddell JN, Bennett AC: Quantification of impact forces in the prevention of sub-concussive head injury using a forensic head model. University of Otago Research Grant.

\$11,380 Tong DC, Waddell JN, Winter T, Bennett AC: Quantification of impact forces to the head using a forensic model. ANZAOMS Research and Education Trust.

\$21,000 Schwass D, Meledandri CJ. Pre-seed funding support from Otago Innovation.

\$40,000: Duncan W – CI, Chandler NP and Waddell JN: A large animal gum-disease model of peri-implantitis and periodontitis in sheep for testing novel treatment strategies. University of Otago Research Grant (UORG).

\$18,000: Duncan W: The Machined Surface Coronal implant in a sheep model of peri-implantitis. Southern Implants Ltd SA.

\$64,400 Schwass D, Meledandri CJ. Evaluating the efficacy of a topical antimicrobial gel formulation for treating peri-implantitis in a sheep model. University of Otago Research Grant.

\$66,340 Duncan WJ and Schmidlin P, Evaluation of novel bone replacement grafts in a sheep animal model. Resorba Medical GmbH, Germany.

\$156,000. Duncan WJ and Schmidlin P, Evaluation of novel bone replacement grafting products for tooth socket preservation and maxillary sinus elevation in a sheep animal model. Zimmer Biomet 3i, United States of America.

\$10,000, Duncan WJ, Coates D, Ye Naung N, Zannicotti D, De Silva RK. Maurice and Phyllis Paykel Trust.

# Clinical and Translational Research

Programme Director: Professor Warwick Duncan

Te Kaupeka Pūniho, New Zealand's National Centre for Dentistry, is the centre of excellence in New Zealand for clinical and translational research in dentistry and oral health. During 2015-16, the Clinical and Translational Research Programme was refreshed and relaunched, with an expanded focus to include Translational Research. 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.

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 Faculty. 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 Faculty by and for New Zealand dental practitioners, with the support of Faculty of Dentistry staff.

## Key personnel

Professor W Duncan  
Professor P Brunton  
Professor B Drummond  
Professor D Tong  
Associate Professor N Chandler  
Associate Professor J Leichter  
Associate Professor N Waddell  
Associate Professor V Bennani  
Associate Professor Tawse-Smith  
Associate Professor L Foster-Page  
Dr M Brosnan  
Dr S Ma

Dr D Schwass  
Dr D Coates  
Dr T Milne  
Dr C Loch Santos Da Silva  
Dr B Al-Amieh  
Dr J Choie  
Ms D Boyd  
Ms C Murray

## ARCH

Dr L Friedlander  
Ms S Hanlin

## Postgraduate students

Seung David Ko	Noel Ye Naung
Leonid Khimovich	Janine Tiu
James Dawson	Syarida Safii
Yevgeny Sheftel	Joanne Choie
Frances Ruddiman	Soo-Wee Ong
Allauddin Siddiqi	Dr Andrew Tawse-Smith
Ajay Sharma	Dr Sunyoung Ma

## Research projects and themes established

### Novel therapeutic agents

Manuka honey antibacterial action against caries – clinical trial

Manuka honey and Manuka oil antibacterial action against periodontitis – *in vitro* and clinical trial

Geranylgeraniol treatment for Bisphosphonate-Related Osteonecrosis of the Jaw (BRONJ) – *in vitro* and preclinical animal model

Novel grafting products for alveolar ridge preservation – clinical trial

Mucograft for gingival and mucosal regeneration – clinical trial

Novel bone grafting products and resorbable membranes for alveolar ridge preservation – preclinical animal model

Silver nanoparticles as antibacterial agents – *in vitro*

Silver nanoparticles in dental materials – *in vitro*

Silver nanoparticle topical gel for treating peri-implantitis and periodontitis – *in vitro* & preclinical animal model

Silver nanoparticle-doped bone xenografts for maxillofacial grafting – *in vitro* & preclinical animal model

### Novel therapeutic approaches

HALL technique for childhood caries – clinical trial  
Tooth preparation with ultrasonics – benchtop  
Tooth preparation and restoration with ceramic materials- benchtop  
Gingival retraction for dental impressions – clinical trial  
Ultrasonic instrumentation of titanium – benchtop  
Diode laser irradiation of titanium surfaces – benchtop  
Novel bone-grafting surgical instruments – benchtop and cadaveric study

### Implant therapy

Anodic modification of titanium and titanium-zirconia alloy – *in vitro* & preclinical animal model  
Zirconia versus titanium one-piece implants – preclinical animal model & randomised clinical trial  
Modified hydrophilic surfaces on dental implants – preclinical animal model

### Stem cell therapy

Adipose-derived stem cell therapy around titanium implants – *in vitro* & preclinical animal model  
Stem cells in dental pulp from deciduous teeth – *in vitro*  
Oral periosteum-derived stem cells – *in vitro*

### Outcomes of treatment

Outcomes of implant therapy in New Zealand private practice – clinical audit  
Maxillary implant-supported overdentures – follow-up of randomised clinical trial  
Mandibular implant-supported overdentures – follow-up of randomised clinical trial  
Periodontal treatment: instrumentation of root surfaces – benchtop  
Clinical success of zirconia implant abutments – follow-up of randomised clinical trial  
Aftermarket versus original implant abutments – preclinical animal model  
Perceptions of implant treatment – qualitative survey  
Piezoelectric surgery vs rotary instruments for lateral maxillary sinus floor elevation – systematic review

### Clinical audit

Referrals for Paediatric treatment – clinical audit  
Dental files used for forensic identification – clinical audit  
Dental treatment in New Zealand soldiers – clinical audit  
Third molar extractions – clinical audit

### Diagnostics

Oral pH and temperature – clinical trial  
Ultrasonic devices for early diagnosis of periodontal diseases – benchtop, preclinical animal trial, clinical trial

### Epidemiology of disease

Children and snoring – clinical survey  
Caries in Māori – clinical survey  
Use of Miswak by New Zealand Muslim immigrants – clinical survey  
Titanium particles and peri-implantitis – clinical and histological survey

Quality assessment of systematic reviews on oral implants – systematic review

### New Animal models

A sheep model of bilateral artificially-induced periodontal disease and periodontitis  
A sheep model for testing bone grafting products in alveolar ridge preservation  
A sheep model for testing bone grafting products in maxillary sinus elevation  
A sheep model for testing modified titanium discs in the femoral epicondyle

### Awards

- Associate Professor Nicholas Chandler received the Alan Docking International Association for Dental Research Science Award, 2016
- Dr Joanne Choi received 25 national and international media reports on her intra-oral pH and temperature device.
- Dr Sunyoung Ma won the SJWRI Publication Award (2015), was awarded 1st place for the Carl E Misch Award for Excellence in Implant Dentistry (2015) and was awarded the J. Morita Junior Investigator Award for Geriatric Oral Research (IADR, 2016).
- Associate Professor Vincent Bennani won the Faculty of Dentistry Research Day Poster Competition (2016).
- Dr Dawn Coates was awarded Faculty of Dentistry's, Sir John Walsh Research Institute, Research Excellence Award in 2016.

### Major grants

Professor W Duncan and co-investigators were awarded \$1,199,869 by the Ministry of Business Innovation and Employment (High Value Manufacturing and Services- Targeted Research) for "UltraD3: Ultrasonic Dental Diagnostic Device" in 2015.



Professor W Duncan and co-investigators were awarded \$999,804 by the Ministry of Business Innovation and Employment (Contestable Research Fund – Smart Ideas) for "Silverbone" – unique antibacterial biomaterial" in 2016.

## Contestable Funding

New Zealand Dental Research Foundation  
Faculty of Dentistry Fuller Grant  
New Zealand Dental Association/Ministry of Health Oral Health Research Grant.  
New Zealand Dental Association Research Foundation Project Grant  
Lottery Health Research  
International College of Dentists Research Fund  
Otago Innovation Ltd (OIL)  
University of Otago Research Grant  
Cure Kids, HRC  
DMG Germany  
Health Research Council of New Zealand  
Manuka Health New Zealand  
Maurice and Phyllis Paykel Trust  
New Zealand Society of Periodontology  
Division of Health Sciences Sandpit fund  
Wishbone Trust

## In-kind support

Ivoclar International Co.  
Southern Implants  
Nobel Biocare  
Neoss  
Geistlich Pharma  
Zimmer Biomet 3i  
Resorba

## Patent applications

D Schwass, C Meledandri, G Cotton (Antimicrobial alginate gel) 2015  
D Schwass, C Meledandri, G Cotton, W Duncan, G Tompkins (Silvergel) 2016

## Collaborations

### Other Departments at Otago University:

Applied Sciences Department, Clothing & Textile Sciences  
Geology Department  
Preventive & Social Medicine Department

Physics Department  
Chemistry Department

## Other Universities

Department of Mechanical Engineering, University of Auckland  
eveDENT (Australian PBRN)  
University of Western Australia  
University of Geneva, Switzerland  
Chonbuk University, Korea  
University of Zürich, Switzerland  
Swiss Federal Institute of Technology at Zürich, Switzerland

## Companies and other entities

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

## Undergraduate clinical research in 2015

Ong, J.Z.T. Practices and philosophies towards vital pulp therapy: A PBRN Study

Twaddle, N.J. Vital Pulp therapy practices in regional New Zealand

Phang, J.; Sim, S.Y. Adolescents and young adults' knowledge and understanding of dental trauma

Tong, A.A.L.H. An audit of children and adolescents with medical problems including genetic anomalies and syndromes receiving care in the Paediatric Dentistry Clinic

Jeganath, J.; Wong, A. New Zealand general dentists' usage and views on caries detection methods

Chow, M.; Costain, S. Knowledge, opinions and practices regarding sugar in oral paediatric medications: A survey of Dunedin pharmacies

Eggleston, A.R.J.; Baker, L.C. Treatment needs and potential funding available for children referred for restorative dental care under general anaesthesia at the University of Otago School of Dentistry

Lim, M.; Lin, R. Prescription of systemic antibiotics by dental specialists in New Zealand

Avau, P.S.; Jahnke, D.J. Oral health perceptions, awareness and preferences in a Dunedin Pacific population, New Zealand

Gatland, C.L.; Geoghegan, G.E. Strategies for the provision of oral health care for institutionalised older adults in New Zealand

Foo, M.; Kim, A.; Lee, D. Comparison of survival rates between single implant crowns (SIC) and short-span tooth-supported fixed bridges: 6-year retrospective study

Lin, T. Convergence angles and margin widths of tooth preparations prepared by New Zealand dental students

Campbell, H., Wilson, J. New Zealand dentist's perspectives on whether recent NZ dental graduates are well equipped for the workforce

Singh, J.K.; Masri, N. Oral health status of New Zealand First World War service personnel

Nichols, G. Bicycle-related facial fractures over a 33-year period: have safety helmets made a difference?

Tan, A.P. Orthodontic screening and referral practices among dental therapists in New Zealand: A qualitative study

Kota, A.; Jayaweera, Y. The effect of standardised implantoplasty protocol on titanium surface roughness: an *in-vitro* study

Ee, S.J.; Tan, J.Y. Dimensional analysis of prosthetic screws supporting single implant crowns after 5 years *in vivo*

## Undergraduate clinical research in 2016

Goh, K., Arrif, A. Current dental practice in New Zealand: anaesthesia, direct restorations, endodontics and bleaching

Hong, C.L. And Lamb, A. Medical emergencies and cross-infection control practices in New Zealand dental practices.

Looi, S., Chua, K.R. New Zealand general dental practitioners' preferred methods and views regarding restoration of root canal treated teeth

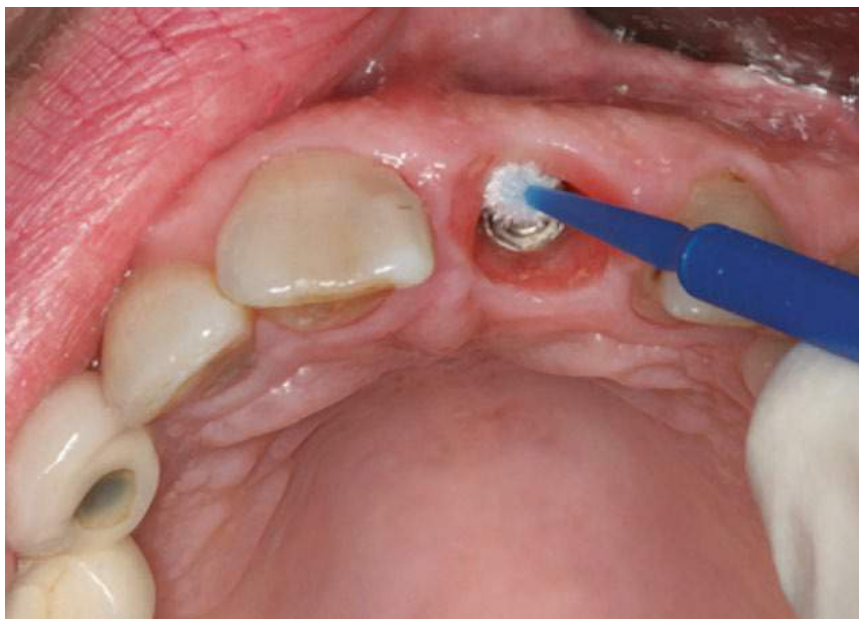
Chew, D.W.S Tooth preparation with ultrasonic instruments. Effects on enamel and dentine surface bonding

Alayan, H., Fernandes, R. The use of miswak among Muslim immigrants living in New Zealand

France, A.J, Laqekoro Z. Pacific adolescents' attitudes to and beliefs about oral health and oral health care

Radu A, Barber H. Presence of titanium particles in the oral mucosa of implants with peri-implantitis

Chuah, W.C. Quality evaluation of dental records in Forensic Odontology



Are Titanium wear particles associated with peri-implantitis? Images from Andrew Tawse-Smith's PhD research showing micro brush sampling of the peri-implant mucosa

## Featured publications

### Book chapters

Drummond, B. K., & Harding, W. (2015). Examination and treatment planning for hypomineralized and/or hypoplastic teeth. In B. K. Drummond & N. Kilpatrick (Eds.), *Planning and care for children and adolescents with dental enamel defects: Etiology, research and contemporary management*. (pp. 99-112). Berlin, Germany: Springer. doi: 10.1007/978-3-662-44800-7

Duncan, WJ (2016). Peri-Implant Bone: Preservation or Reconstruction? In: *Current Issues in Periodontics*, PM Bartold, Kemal Y, eds., Asian Pacific Society of Periodontology: Adelaide, ISBN 978-0-646-95464-6.

Friedlander, L., McElroy, K., Daniel, B., Cullinan, M., & Hanlin, S. (2015). Direct pulp capping of permanent teeth in New Zealand general dental practice: A practice based research study. *New Zealand Dental Journal*, 111(2), 58-64.

Chandler, N. P. (2017). Root canal filling. In B. S. Chong (Ed.), *Harty's endodontics in clinical practice*. (7th ed.) (pp. 151-173). Edinburgh, UK: Elsevier. ISBN 9780702058356

### Journal publications

Tong, D. C., & Breeze, J. (2016). Damage control surgery and combat-related maxillofacial and cervical injuries: A systematic review. *British Journal of Oral & Maxillofacial Surgery*, 54, 8-12.

Choi JE, Loke C, Waddell JN, Lyons KM, Kieser JA, Farella M (2015). Continuous measurement of intraoral pH and temperature: Development, validation of an appliance and a pilot study. *Journal of Oral Rehabilitation* 42:563-570.

Duncan, W. J., Gay, J. H. A., Lee, M.-H., Bae, T.-S., Lee, S.-J., & Loch, C. (2016). The effect of hydrothermal spark discharge anodization in the early integration of implants in sheep sinuses. *Clinical Oral Implants Research*, 27(8), 975-980.

Chow, M., Costain, S., Brosnan, M., & Murray, C. (2016). Knowledge, opinions and factors influencing practices regarding sugar in oral paediatric medications: A survey of Dunedin pharmacy staff. *New Zealand Dental Journal*, 112(2), 33-38.

Bennani V, Aarts J, Schumayer M (2016). Correlation of pressure and displacement during gingival displacement: An *in vitro* study. *J Prosthet Dent*; 115, 3:296-300

Tawse-Smith A, Ma S, Duncan WJ, Gray A, Reid MT, Rich AM (2016). Implications of wear at the titanium-zirconia implant-abutment interface on the health of peri-implant tissues. *International Journal of Oral & Maxillofacial Implants - JOMI-2015-562/R1 - (5014)*,

Ma, S., Tawse-Smith, A., De Silva, R. K., Atieh, M. A., Alsabeeha, N. H. M., & Payne, A. G. T. (2016). Maxillary three-implant overdentures opposing mandibular two-implant overdentures: 10-year surgical outcomes of a randomized controlled trial. *Clinical Implant Dentistry & Related Research*, 18(3), 527-544.

Zafar, S., Coates, D. E., Cullinan, M. P., Drummond, B. K., Milne, T., & Seymour, G. J. (2016). Effects of zoledronic acid and geranylgeraniol on the cellular behaviour and gene expression of primary human alveolar osteoblasts. *Clinical Oral Investigations*, 20, 2023-2035.

Zanicotti, D. G., Coates, D. E., & Duncan, W. J. (2016). In vivo bone regeneration on titanium devices using serum-free grown adipose-derived stem cells, in a sheep femur model. *Clinical Oral Implants Research*. Feb 8. [Epub ahead of print]

Sharma, A., McQuillan, A. J., Shibata, Y., Sharma, L. A., Waddell, J. N., & Duncan, W. J. (2016). Histomorphometric and histologic evaluation of titanium-zirconium (αTiZr) implants with anodized surfaces. *Journal of Materials Science: Materials in Medicine*, 27(5), 86.

Liu, J., Schmidlin, P. R., Philipp, A., Hild, N., Tawse-Smith, A., & Duncan, W. (2015). Novel bone substitute material in alveolar bone healing following tooth extraction: An experimental study in sheep. *Clinical Oral Implants Research*. Advance online publication. doi: 10.1111/clr.12673

Siddiqi, A., Kieser, J. A., De Silva, R. K., Thomson, W. M., & Duncan, W. J. (2015). Soft and hard tissue response to zirconia versus titanium one-piece implants placed in alveolar and palatal sites: A randomized control trial. *Clinical Implant Dentistry & Related Research*, 17(3), 483-496. doi: 10.1111/cid.12159

Tiu, J., Al-Amleh, B., Waddell, J. N., & Duncan, W. J. (2015). Reporting numeric values of complete crowns: Part 1: Clinical preparation parameters. *Journal of Prosthetic Dentistry*, 114(1), 67-74. doi: 10.1016/j.prosdent.2015.01.006

# Craniofacial biology and clinical oral physiology

Programme leader: Professor Mauro Farella

The *Craniofacial Biology and Clinical Oral Physiology* 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, and 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 biology, 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.

Research in the field of clinical oral physiology 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.

## Highlights 2015-2016

In total 33 articles were published in the peer-reviewed scientific literature. For details, please refer to the Publications data in the 'Our Achievements' section of the 2015-16 SJWRI Research Report. The total number of conference presentations made was 32 (including 8 keynote addresses).

Total research funding (external) obtained in 2015-2016 amounted to \$492,271.

Prof Farella was the recipient of the Alan Docking Award from the International Association for Dental Research (2015), and of the Sir John Walsh Award (2015), to acknowledge the excellence achieved in dental research.

Li Mei won the SJWRI Clinical Research Award 2015

Gareth Benic won the prize for the best research presentation within the Research Programme in Craniofacial Biology and Clinical Oral Physiology at the 2016 Research Day.

PhD (Theses submitted): Andrew Quick, Ghassan Idris, Erin Hutchinson.

Doctor of Clinical Dentistry (completed): Andrew Parton, Sophie Gray, Shahrzad MacAvoy, Coreen Loke, Mohamad Al-Dujaili, Lydia Meredith, Yana Itskovich, Azza Al-Ani, Catherine Carleton, Gareth Benic.

Master of Health: Austin Kang

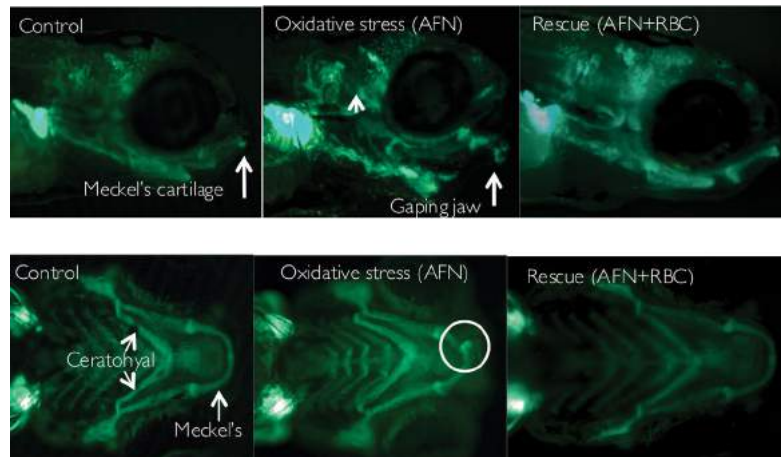
Honours Students: Erni Park, Sharifa Al Balushi, Sherry Lee.

## Research projects

A novel model for exploring the causes and treatments of craniofacial birth defects

**Research Team:** Catherine Carleton, Julia Horsefield, Joseph Antoun, and Mauro Farella

The aim of this research was to determine how environmental causes of craniofacial birth defects affect the growth and survival of cells contributing to the craniofacial skeleton during embryonic development. A second objective was to determine whether factors that enhance cell survival, such as antioxidant molecules, could rescue craniofacial defects. Our findings indicate that oxidative stress in a zebrafish model results in craniofacial cartilage defects that can be rescued by the antioxidant RiboCeine. These findings may have translational significance, as treatment with antioxidants may help to prevent craniofacial defects in children, especially in families where there is an identified genetic or environmental risk.

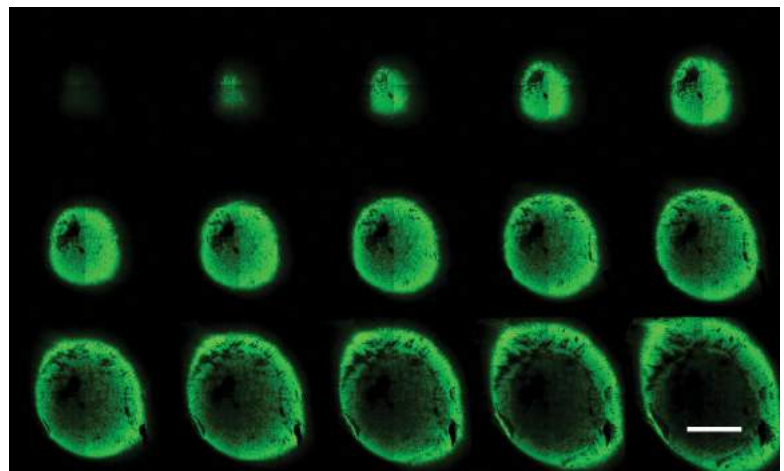


Zebrafish embryos exposed to oxidative stress (Auranofin) developed a gap jaw defect. Treatment with the antioxidant RiboCeine™ rescued the jaw defect so that the embryos had the appearance of untreated controls fish.

A new approach to engineering 3-dimensional constructs of human bone matrix in a mechanically-active environment

**Research Team:** Yana Itskovich, Murray Meikle, Trudy Milne, Richard Cannon, and Mauro Farella

The development of suitable alternatives to autogenous and allogeneic bone has been a goal of bone and biomaterials research for many years. An autograft is the biologic gold standard against which biocompatibility of all new materials are compared. Numerous materials have been tested, but with limited success. The present research uses a semi-synthetic hydrogel, which provides a close resemblance of the extracellular matrix, and the opportunity to modify the gel cross-linking ratios. The aim of the present study was to develop a 3-dimensional cell culture model and to validate assays that could be used to aid the engineering of an artificial mineralized bone matrix *in vitro*. We have examined the proliferation and hydroxyapatite deposition of human femoral and calvarial osteoblasts cultured in two modifications of a thiol-modified hyaluronan-gelatin-PEGDA cross-linked hydrogel. A hydrogel construct has also been cultured under intermittent compressive mechanical strain and preliminary gene expression analysis undertaken.



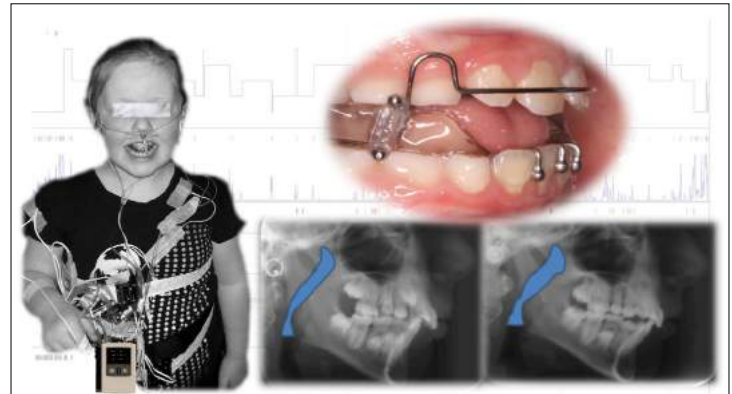
Fluorescently labelled viable human osteoblasts grown in a 3-D gel. Serial sections of gel were photographed using a confocal microscope.

## Efficacy of a mandibular advancement appliance on Sleep Disordered Breathing in Children

**Research Team:** Ghassan Idris, Barbara Galland, Chris Robertson, and Mauro Farella

Sleep-Disordered Breathing (SDB) varies from habitual snoring to partial or complete obstruction of the upper airway, and can be found in up to 10% of children. SDB can significantly affect children's wellbeing, as it can cause growth disorders, educational and behavioural problems, and even life-threatening conditions, such as cardiorespiratory failure. In patients with craniofacial anomalies, for whom adenotonsillectomy or other treatment modalities have failed, or surgery is contraindicated, mandibular advancement splints (MAS) may represent a viable treatment option. We designed a crossover randomised controlled trial to determine the efficacy of mandibular advancement appliances (MAS) for the management of Sleep-Disordered Breathing (SDB) and related health conditions in children.

The Apnoea Hypopnoea Index (AHI) represented the main outcome variable and was assessed via home-based polysomnography. Compared to a Sham MAS, wearing an Active MAS resulted in a significant reduction in AHI and snoring time.



A patient with sleep disordered breathing wearing an oral appliance to increase oropharyngeal airway. Polysomnography is used for a home-based sleep study.

Our preliminary findings indicate that the short-term use of mandibular advancement splints significantly reduced AHI, supine AHI, and snoring time in children with SDB, and improved subjectively assessed SDB symptoms and quality of life, in addition to significant changes in children's behaviour.

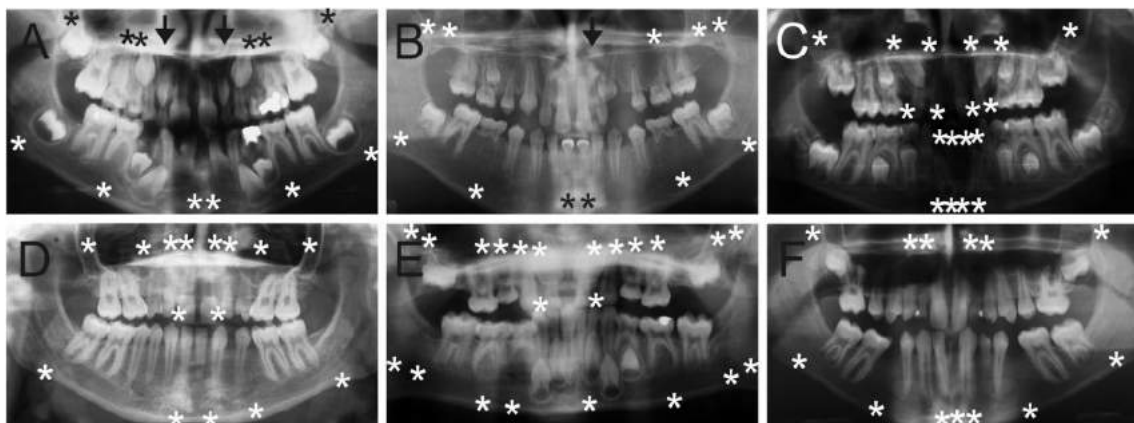
## Environmental and genetic factors associated with hypodontia

**Research Team:** Azza Al-Ani, Joseph Antoun, Mauro Farella, Murray Thomson, and Tony Merriman

Hypodontia, or tooth agenesis, is the most prevalent craniofacial malformation in humans. Both environmental and genetic factors are involved in the aetiology of hypodontia, with the latter playing a more significant role. The objectives of this study were two-fold: (1) to investigate the association between non-syndromic hypodontia and single nucleotide polymorphisms (SNPs) of candidate genes paired box 9 (*PAX9*), *msh* homeobox 1 (*MSX1*), axis inhibition

protein 2 (*AXIN2*), and ectodysplasin A (*EDA*); and (2) to examine its association with environmental factors, such as exposure to smoking and alcohol during pregnancy.

Our preliminary findings reveal some evidence that polymorphisms of the *EDA* and *PAX9* genes are associated with specific phenotypes of non-syndromic hypodontia. Furthermore, this research is the first to date to test the association between maternal cigarette smoking during pregnancy and having a child with hypodontia.



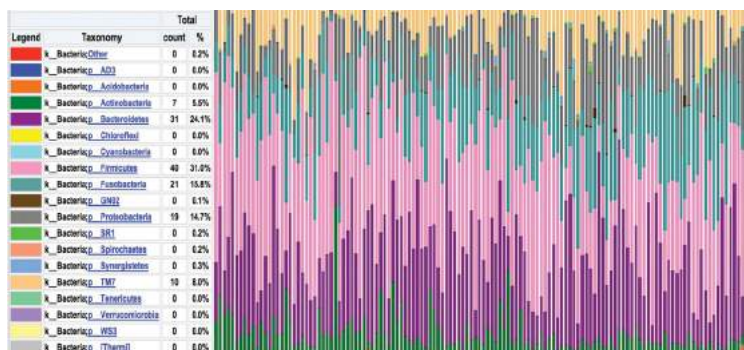
Orthopantomographs showing different patterns (see asterisks) of hypodontia and oligodontia.

## Efficacy of oral probiotics in managing biofilm formation in patients wearing fixed orthodontic appliances

**Research team:** Gareth Benic, Mauro Farella, Patrick Biggs, Nicholas Heng, Richard Cannon, and Li Mei

This research aims to investigate the efficacy of the oral probiotic *Streptococcus salivarius* M18 on managing biofilm formation in patients wearing fixed orthodontic appliances. We have designed a prospective, randomized, triple-blind, two-arm parallel-group, placebo-controlled trial in patients undergoing fixed orthodontic treatment. The outcome measures were plaque index (PI), gingival index (GI) and halitosis-causing volatile sulphur compound (VSC) levels. Oral microflora was analysed utilising next-generation sequencing of the bacterial 16S rRNA gene.

Our preliminary findings indicate that the oral probiotic *S. salivarius* M18 reduced the VSC levels in patients with fixed appliances but did not decrease their plaque or gingival indices. The influence of probiotic *S. salivarius* M18 on oral microflora seems to be minimal. A longer intervention and follow-up period are needed.

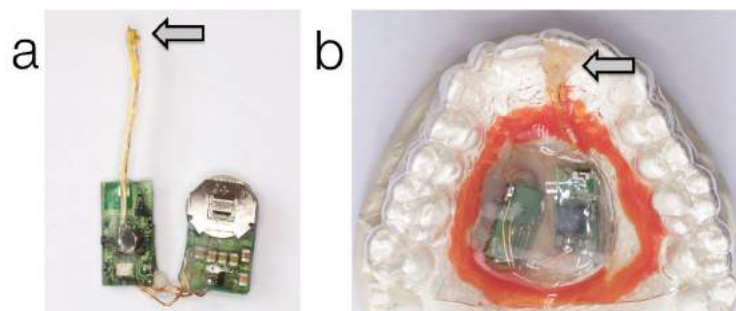


Distribution of phyla (Y-axis) from samples of oral plaque (X-axis) sequenced, in orthodontic patients.

## Wireless Monitoring of Intra-oral pH

**Research Team:** Coreen Loke, Mauro Farella, Sylvia Sander, and Richard Cannon.

Intra-oral pH plays a significant role in the pathogenesis of tooth wear as well as white spot lesions in patients with fixed or removable orthodontic appliances. However, there is currently very little information about intra-oral pH variation over time, and in real life settings. The aims of this research were 1) to develop a wireless monitoring intra-oral pH device, which can be used to record real-time pH and temperature data in a natural environment, in which participants carry out their normal daily activities; and 2) to collect preliminary data in a sample of healthy volunteers, in a manner that is as non-invasive as possible, for over 24 hours.



Example of wireless device for measuring intraoral pH. a) Tip of antimony electrode (see arrow). b) wireless unit embedded in a vacuum-formed splint.

The wireless device consisted of a miniature pH telemeter, which included a temperature sensor and is capable of transmitting data wirelessly to a smartphone. A monitoring and calibration software application was also developed and was used to aid data input from the participants. *In vitro* tests were conducted to calibrate and validate the measurements of the device, and the measurements were tested against a gold standard reference electrode. The wireless device was then embedded into an in-mouth appliance and worn by a number of participants for at least 24 hours, while conducting regular daily activities.

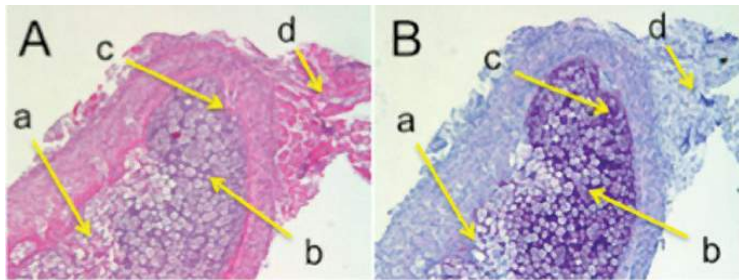
Preliminary results suggest that real-time variations in intra-oral pH and temperature can be successfully collected in participants. This wireless device is therefore capable of providing new insights into the variations of intra-oral pH over time, and its relationship with dental wear, white spot and caries.

## Growth factor expression in the condylar cartilage of rats

**Research Team:** Mohamad Al-Dujaili, Trudy Milne, Richard Cannon, and Mauro Farella

The mandibular condylar cartilage has attracted significant interest in orthodontic research, as it is a key site of growth and development of the mandible. The aim of this research was to assess the expression of an array of growth factors and to identify changes in their regulation during early stages of growth. Condyles were extracted from rats aged 4, 10, 21 or 90 days, processed through a validated RNA extraction protocol, and subjected to histological analysis. Quantitative polymerase chain reaction (qPCR) was used to compare the relative gene expression of 28 growth factor-related genes. There were detectable changes in the regulation of genes involved in chondrogenesis and osteogenesis for each age group. However, none of the growth factor genes showed a change greater than two-fold. The present study showed that the cryogenic grinding protocol was a

valid technique for extracting RNA from rat condyles and that all the growth factors analysed were present. However, only weak evidence is provided for the regulation of the growth factors investigated at any of the selected time points.



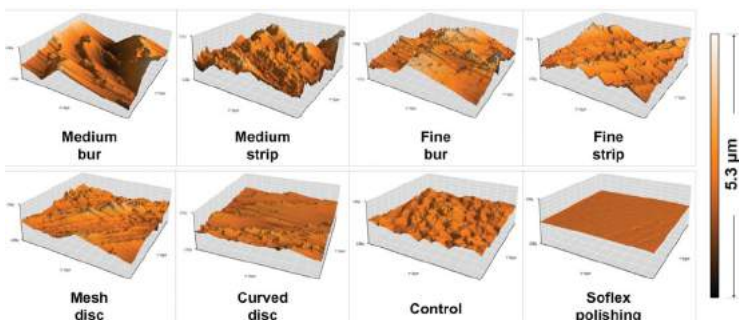
Coronal sections of the condyle of a 4-day old rat. Sections stained with H&E (A) and TB (B). 100X magnification a) eroded cell layer b) hypertrophic cell layer c) resting cell layer d) muscle tissue.

## The influence of orthodontic interproximal reduction on enamel roughness and bacterial adhesion

**Research Team:** Lydia Meredith, Li Mei, Richard Cannon, and Mauro Farella

Interproximal reduction (IPR), also known as enamel stripping, is becoming more and more popular in orthodontics, but it leaves many grooves and furrows on the enamel surface, which may increase the risk of caries. We investigated the influence of IPR on the morphology and roughness (Ra) of enamel surfaces and the bacterial adhesion to these surfaces. The specific aims of this research were to assess the roughness of enamel surfaces (both qualitatively and quantitatively) produced by the most commonly used IPR instruments, to investigate the adhesion of bacteria to these surfaces, and to evaluate the effect of polishing after IPR on the amount of bacterial adhesion.

Extracted human premolar teeth were used to prepare enamel blocks, which were subjected to interproximal reduction. The morphology and roughness of the enamel surfaces were investigated qualitatively and



Examples of atomic force microscopy 3D images of enamel surfaces after using different IPR instruments.

quantitatively using atomic force microscopy. From the seven IPR-treated groups, the samples from the three instruments that yielded significantly different roughnesses, as well as the control group, were used for the adhesion experiments. Adhesion of *Streptococcus sanguinis* ATCC10556 to the enamel surfaces was assessed by counting the colony forming units that adhered to the roughened surfaces after 30 min exposure.

The findings suggest that diamond burs created the roughest enamel surfaces, followed by diamond strips, followed by diamond discs. The Soflex polishing discs created the smoothest surfaces, even smoother than that of the untreated enamel. There was a positive relationship between enamel surface roughness and the number of bacteria that adhered.

## Other research projects

- 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
- The influence of orthodontic therapy on mandibular motion
- Genetic aspects of the long face
- Growth factor expression in the rat condyle: implications for craniofacial development
- Intra-oral monitoring of oral pH and bruxism
- Mandibular growth in 3D: CBCT analysis in a rabbit model.
- Intraoral pressure changes upon varying the vertical facial dimension.
- Morphometric analysis of cervical vertebrae in relation to mandibular growth

## Research funding

*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 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



*New Zealand Dental Research Foundation* Genetic and psychological factors associated with orthodontic pain in children and adolescents (Farella M, Antoun J, Chandler N, Merriman T, Sew Hoy W) \$8,441

*New Zealand Dental Research Foundation* Jaw muscle overload as a possible cause of orofacial pain and headache (Farella M, Ramanan D, Polonowita A, Hamilton J, Palla S). \$12,350.

*Lottery Health Grant* "3dMD Trio Imaging System and Software for 3D imaging of the face". Supported by Lottery Health Grant (Mauro Farella, Joseph Antoun) \$90,000

*ERDG/FORENZAO Charitable Trust* "Efficacy of a Mandibular Advancement Appliance on Sleep Disordered Breathing in Children (Ghassan Idris, Mauro Farella, Barbara Galland, Jules Kieser) \$10,100.

*CureKids Charitable Trust* "Efficacy of a Mandibular Advancement Appliance on Sleep Disordered Breathing in Children (Mauro Farella, Ghassan Idris, Barbara Galland, Jules Kieser) \$31,782

*Ministry of Oral Health* "Efficacy of a Mandibular Advancement Appliance on Sleep Disordered Breathing in Children (Mauro Farella, Ghassan Idris, Barbara Galland, Jules Kieser) \$24,734

*Health Research Council* Genetics of dentofacial anomalies (Joseph Antoun, Mauro Farella, Tony Merriman, Murray Thomson) \$149,462

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

*New Zealand Dental Association Research Foundation* A novel model for exploring the causes and treatments of craniofacial birth defects (Julia Horsfield, Joseph Antoun, Mauro Farella, Catherine Carleton) \$10,400

*Otago Medical Research Foundation* A novel model for exploring the causes and treatments of craniofacial birth defects (Julia Horsfield, Joseph Antoun, Mark Hampton) \$30,000

*New Zealand Dental Association Research Foundation* A new approach to engineering 3D constructs of human bone matrix in a mechanically active environment (Murray Meikle, Trudy Milne, Yana Itskovich, Mauro Farella, Richard Cannon) \$11,862

*New Zealand Dental Association Research Foundation* Growth factor expression in the rat condyle: Implications for craniofacial development (Trudy Milne, Mauro Farella, Li Mei, Richard Cannon, Mohamad Al-Dujaili) \$14,042

## Key personnel

The programme is led by Professor Mauro Farella, and includes the following SJWRI researchers:

Dr Joseph Antoun  
Florence Bennani  
Prof Richard Cannon  
A/Prof Rohana De Silva  
Professor Mauro Farella  
Dr Winifred Harding  
A/Prof Nick Heng  
Dr Hannah Jack  
Dr Carolina Loch Santos da Silva  
Dr Li Mei  
Dr Trudy Milne  
Dr Christopher Robertson  
Dr Benedict Seo  
Suzan Stacknik  
Prof Murray Thomson  
  
A/Prof Geoffrey Tompkins  
Dr Mike Brosnan  
A/Prof Nick Chandler  
Dr Harsha De Silva  
Prof Warwick Duncan  
A/Prof Lyndie Foster Page  
Prof Karl Lyons  
Dr Ajith Polonowita  
A/Prof Neil Waddell

## Postgraduate students

Sabarinath Prasad (2016) (PhD)  
Joseph Antoun (PhD)  
Erin Hutchinson (PhD)  
Ghassan Idris (PhD)  
Andrew Quick (PhD)  
Joanne Choi (2015) (PhD)  
Ana Low (DClinDent)  
Caleb Lawrence (DClinDent)  
Divya Ramanan (DClinDent)  
Fiona Firth (DClinDent)  
Will Sew Hoy (ODClinDent)  
Austin Kang (DClinDent)  
Azza Al-Ani (DClinDent)  
Gareth Benic (DClinDent)  
Catherine Carleton (DClinDent)  
Yana Itskovich (DClinDent)  
Mohamad Al-Dujaili (DClinDent)  
Coreen Loke (DClinDent)  
Lydia Meredith (DClinDent)  
Austin Kang (MHealSc)

## Research collaborations

The research group actively collaborates with other renowned scientific groups within the University of Otago such as:

Center for Bioengineering and Nanomedicine

Department of Anatomy

Department of Chemistry

Department of Physics

Department of Computer Science

Department of Human Nutrition

Department of Physics

Department of Zoology

D4 Network

Genetics Otago

Neuroscience Programme

Otago Zebrafish Facility

Pain@Otago

The programme also collaborates with the MedTech Centre of Research Excellence (CoRE), the Consortium for Medical Device Technologies (CMDT), the New Zealand Biomouth Research Group, and internationally works closely with the Department of Neuroscience at the University of Naples Federico II (Italy) and the Laboratory for Jaw Biomechanics at the University of Zurich (Switzerland).

## University of Otago collaborators

Dr Azam Ali (Department of Applied Sciences)

Mr Hamza Bennani (Department of Computer Science)

Dr Claire Cameron (Department of Preventive & Social Medicine)

A/Prof George Dias (Department of Anatomy)

A/Prof Julia Horsfield (Department of Pathology)

A/Prof Barbara Galland (Department of Women's and Children's Health)

Dr Louise Mainvil (Department of Human Nutrition)

Prof Tony Merriman (Department of Biochemistry)

A/Prof Michael Paulin (Department of Zoology)

A/Prof Sylvia Sander (Department of Chemistry)

Prof. Steven Robertson (Department of Women's and Children's Health)

Dr Bernard Venn (Department of Human Nutrition)

Dr Louise Mainvil (Department of Human Nutrition)

## Overseas collaborators

Prof Alan Brook (University of Adelaide)

Dr Iacopo Cioffi (University of Toronto)

Jie Fang (Sichuan University)

Prof Luigi Gallo (University of Zurich)

A/Prof David Healey (University of Brisbane)

Prof Beverley Kramer (University of Johannesburg)

Jialing Li (Nanjing Medical University, China)

Prof Ambra Michelotti (University of Naples, Federico II)

Em Prof Sandro Palla (University of Zurich)

## Visiting scientists and students

Em Prof Sandro Palla (University of Zurich)

Prof Philip Benson (University of Sheffield)

Dr Annemarie Renkema (University of Nijmegen)

Mr Aurelio Songini (University of Cagliari)

Dr Francesca Fabiano (University of Messina)

## Key publications

Hutchinson EF, Farella M, Kramer B. Variations in bone density across the body of the immature human mandible. *Journal of Anatomy*, 2016. Accepted for publication.

Meredith L, Mei L, Cannon RD, Farella M. Atomic force microscopy analysis of enamel nanotopography following interproximal reduction. *Am J Orthod*, 2016. Accepted for publication.

Antoun JS, Thomson M, Merriman T, Farella M. Impact of Facial Divergence on Oral Health-Related Quality of Life and Self-Report Jaw Function. *Korean J Orthod*, 2016. Accepted for Publication.

Antoun JS, Mei L, Gibbs K, Farella M Effect of Orthodontic Treatment on the periodontal tissues. *Periodontology 2000*. Accepted for publication, 2016.

Tan A, Bennani F, Thomson WM, Farella M, Mei L. A qualitative study of orthodontic screening and referral practices among dental therapists in New Zealand. *Aust Orthod J* 2016; 32: In press.

Healey D, Gauld R, Thomson WT. Treatment-associated changes in malocclusion and oral health-related quality of life: A 4-year cohort study. *Am J Orthod*, 2016. In press.

Gray, S., Stacknik, S., & Farella, M. (2016). Space maintenance: An overview for clinicians. *New Zealand Dental Journal*, 112(3), 76-80.

Fang J, Li YF, Zhang K, Zhao Z, Mei L. Escaping the adverse impacts of NSAIDs on tooth movement during orthodontics: current evidence based on a meta-analysis. *Medicine* 2016;95:e3256.

Fang J, Wang C, Li YF, Zhao Z, Mei L. Comparison of bacterial adhesion to dental materials of polyethylene terephthalate (PET) and polymethyl methacrylate (PMMA) using atomic force microscopy and scanning electron microscopy. *Scanning*. 2016. Mar 15.

- Antoun JS, Thomson WM, Merriman TR, Farella M. Self-Reported Oral Behaviour Habits in Hyperdivergent and Normodivergent Facial Types. *J Oral Rehabil.* 2016 Oct 17.
- Ong DC, Itskovich Y, Dance G. Autotransplantation: A Viable Treatment Option for Adolescent Patients with Significantly Compromised Teeth. *Aust Dent J.* 2016 Mar 30.
- Idris G, Galland B, Robertson CJ, Farella M. Efficacy of a Mandibular Advancement Appliance on Sleep Disordered Breathing in Children: A Study Protocol of a Crossover Randomized Controlled Trial. *Front Physiol.* 2016 Aug 19;7:353.
- Park JE, Gray S, Bennani H, Antoun JS, Farella M. Morphometric growth changes of the nasopharyngeal space in subjects with different vertical craniofacial features. *Am J Orthod Dentofacial Orthop.* 2016;150(3):451-8.
- Loke C, Lee J, Sander S, Mei L, Farella M. Factors affecting intra-oral pH - a review. *J Oral Rehabil.* 2016;43(10):778-85.
- Farella M, Loke C, Sander S, Songini A, Allen M, Mei L, Cannon RD. Simultaneous wireless assessment of intra-oral pH and temperature. *J Dent.* 2016;51:49-55.
- MacAvoy SK, Jack HC, Kieser J, Farella M. Effect of occlusal vertical dimension on swallowing patterns and perioral electromyographic activity. *J Oral Rehabil.* 2016;43(7):481-7.
- Gray S, Bennani H, Kieser JA, Farella M. Morphometric analysis of cervical vertebrae in relation to mandibular growth. *Am J Orthod Dentofacial Orthop.* 2016;149(1):92-8.
- Parton AL, Duncan WJ, Oliveira ME, Key O, Farella M. Implant-based three-dimensional superimposition of the growing mandible in a rabbit model. *Eur J Orthod.* 2016;38(5):546-52.
- Michelotti A, Iodice G, Piergentili M, Farella M, Martina R. Incidence of temporomandibular joint clicking in adolescents with and without unilateral posterior cross-bite: a 10-year follow-up study. *J Oral Rehabil.* 2016;43:16-22.
- Wang Y, Mei L, Gong L, He S, Ji Y, Sun W. Remineralization of early enamel caries lesions using different bioactive elements containing toothpastes: an *in vitro* study. *Technology and Health Care* 2016;24(5):701-11.
- Zheng Q, Yin P, Fang J, Xu X, Mei L. The effect of resin infiltration vs. fluoride varnish in enhancing enamel surface conditions after interproximal reduction. *Dental Materials Journal* 2016; 35(5): 756–761.
- Duan P, Qu W, Zou S, Chen Y, Lan H, Farella M, Mei L. Influence of fixed orthodontic treatment on the menstrual cycle of adult females: A prospective longitudinal study. *Angle Orthod.* 2016;86(3):475-80.
- Healey DL, Gauld RD, Thomson WM. The socio-demographic and malocclusion characteristics of adolescents presenting for specialist orthodontic treatment in New Zealand practices. *Aust Orthod J.* 2015 May;31(1):20-5.
- Cioffi I, Farella M, Festa P, Martina R, Palla S, Michelotti A. Short-Term Sensorimotor Effects of Experimental Occlusal Interferences on the Wake-Time Masseter Muscle Activity of Females with Masticatory Muscle Pain. *J Oral Facial Pain Headache.* 2015;29(4):331-9.
- Newman TA, Carleton CR, Leeke B, Hampton MB, Horsfield JA. Embryonic oxidative stress results in reproductive impairment for adult zebrafish. *Redox Biol.* 2015 Dec;6:648-55.
- Antoun JS, Fowler PV, Jack HC, Farella M. Oral health-related quality of life changes in standard, cleft, and surgery patients after orthodontic treatment. *Am J Orthod Dentofacial Orthop.* 2015 Oct;148(4):568-75.
- Hutchinson EF, Farella M, Kramer B. Importance of teeth in maintaining the morphology of the adult mandible in humans. *Eur J Oral Sci.* 2015 Aug 19.
- Loch C, Kieser JA, & Fordyce, RE Enamel ultrastructure in fossil cetaceans (Cetacea: Archaeoceti and Odontoceti). *PLoS ONE*, 2015; 10(1), e01165
- White AK, Venn B, Lu LW, Rush E, Gallo LM, Yong JL, Farella M. A comparison of chewing rate between overweight and normal BMI individuals. *Physiol Behav.* 2015 Jun 1;145:8-13.
- Choi JE, Loke C, Waddell JN, Lyons KM, Kieser JA, Farella M. Continuous measurement of intra-oral pH and temperature: development, validation of an appliance and a pilot study. *J Oral Rehabil.* 2015 Aug;42(8):563-70.
- Antoun JS, Cameron C, Sew Hoy W, Herbison P, Farella M. Evidence of secular trends in a collection of historical craniofacial growth studies. *Eur J Orthod.* 2015 Feb;37(1):60-6.
- Li J, Huang Z, Mei L, Li G, Li H. Anti-caries effect of arginine-containing formulations *in vivo*: A systematic review and meta-analysis. *Caries Research.* 2015; 49(6):606-617.
- Zhu M, Li J, Chen B, Mei L, Tian J, Li H. The Effect of Calcium Sodium Phosphosilicate on Dentin Hypersensitivity: A Systematic Review and Meta-Analysis. *PLoS One* 2015;10(11):e0140176.

# Dental Education Research

Programme leader: Dr Lee Adam

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.

## Research Projects

### Do multifaceted admission processes predict performance of students in two Australasian dental programmes?

**Investigators:** Professor. A. Rich, Dr J. Rountree, Professor. G. Seymour (University of Otago), Dr D. Lekkas, Associate Professor T. Winning & Professor G. Townsend (University of Adelaide). Funded by the UMAT Consortium (\$100,000)

The overall aim of this study is to investigate the relationship between the various components of multifaceted admission processes and academic and clinical performance of dental students (2005 – 2012) in two Australasian dental programmes. In addition, the study aims to identify what combination of admission components best predicts success of dental students. The long-term objective is to ensure that admission of dental students at the Universities of Otago and Adelaide continues to be undertaken using reliable, valid and efficient methods, that the skills of successful applicants are matched with our respective curricula requirements, and that the process is socially accountable.

### Stress and mood states of New Zealand dental students

**Investigators:** Professor P. Brunton, Dr J. Broadbent, Dr L. Adam, Professor A. Rich, Mrs A. Meldrum (University of Otago) & Dr L. Jones (Massey University).

The aim of this study is to identify the stress, mood states and resilience of University of Otago Faculty of Dentistry undergraduate dental students. Information is being collected twice yearly using the Perceived Stress Scale Questionnaire (PSS), the Profile of Mood States Questionnaire (POMS-Bi), and a brief resilience scale. The research results will provide important information that can be used, where appropriate, to create a healthier learning environment for students, and to help inform appropriate support interventions, if necessary.

### Feedback processes in the clinical dental learning environment

**Investigators:** Dr L. Adam, Ms S. Ebbeling, Mrs A. Meldrum, Professor A. Rich & Dr A. McLean.

The aim of this project is to identify characteristics of effective feedback in the clinical dental education setting and to develop a set of resources for supporting and improving the approach to feedback by clinical teaching staff in the Bachelor of Oral Health (BOH) and Bachelor of Dental Surgery (BDS) programmes.

## Professionalism for the undergraduate oral health professional

**Investigators:** Mrs R. Ahmadi, Dr L. Smith, Dr L. Adam, Mrs A. Meldrum & Dr S. Moffat.

This project is an investigation of Bachelor of Oral health (BOH) students' development of professionalism through their degree course. Data for the study comprises a review of the first year BOH curriculum in which the fundamentals of professionalism are taught, alongside interviews with staff and students from all years of the BOH programme. The results of the research will help inform the development of the BOH curriculum in regards to teaching professionalism.

## Perceptions of stressors of undergraduate students

**Investigators:** Mrs H Olson, Dr L. Adam, Dr A. Tawse-Smith & Dr S. Moffat.

The aim of this study is to identify University of Otago Faculty of Dentistry undergraduate students' perceived stressors. Data collection is via the Dental Environment Stress Survey (DES). The research results will provide important information that can be used, where appropriate, to create a healthier learning environment for students, and assist students to develop strategies for managing stress in the future.



Hanna Olson presenting her research at the 2016 College of Oral Health Academics (COHA) conference in Adelaide.

## Measuring the attitudes of dental students towards social accountability

**Investigators:** Associate Professor L. Foster Page, Professor J. McMilian, Professor K. Lyons, Professor B. Gibson, V. Chen & C. Fisher

The aim of this project is to develop a social accountability measure for the dental environment. Data was gathered using a modified version of the Medical Students' Attitudes Towards Underserved (MSATU) questionnaire. The instrument's validity was assessed by an expert panel of eight academics and face validity was conducted with six students prior to a pilot study of BDS students. The instrument was consequently revised and further testing is required to ensure its robustness for measuring the concept of social accountability in New Zealand dental students.



BDS Honours student Calum Fisher was awarded Best Oral Presentation in the Dental Education session at the 2016 SJWRI Research Symposium.

## Grants and funding

Mrs R. Ahmadi, Dr L. Adam, Dr L. Smith, Mrs A. Meldrum. *Professionalism for the Undergraduate Professional*. University of Otago Teaching Development Grant \$19,087

Dr L. Adam, Ms A. Meldrum, Prof. A. Rich, Dr A. McLean. *Guidelines for providing feedback in the clinical dental setting*. University of Otago Teaching Development Grant, \$10,075

## Key personnel

Lee Adam  
Jonathan Broadbent  
Paul Brunton  
Peter Cathro  
Nick Chandler  
Lyndie Foster-Page  
Suzanne Hanlin  
Wendy-Ann Jansen van Vuuren  
Karl Lyons  
Alison Meldrum  
Colleen Murray  
Kate Newsham-West  
Hanna Olsen  
Alison Rich  
Janet Rountree  
Lee Smith  
Andrew Tawse-Smith  
Murray Thomson



Lee Smith presents her research in the Dental Education session of 2016 SJWRI Research Symposium, chaired by Lee Adam.

## Key Publications

Adam, L. (2015). Student perspectives on plagiarism. In T. Bretag (Ed.), *Springer handbook of academic integrity*. Singapore: Springer. doi: 10.1007/978-981-287-079-7\_67-1.

Adam, L. Anderson, V. & Spronken-Smith, R. (2016). "It's not fair": Policy discourses and students' understandings of plagiarism in a New Zealand university. *Higher Education* DOI: 10.1007/s10734-016-0025-9.

Chen, V., Foster Page L.A., McMillan J., Lyons K.M. & Gibson B.J. (2015). Measuring the attitudes of dental students towards social accountability following dental education – Qualitative findings. *Medical Teacher* DOI:10.3109/0142159X.2015.1060303.

Cox, S., Pollock, D., Rountree, J., & Murray, C.M. (2016). Use of information and communication technology amongst New Zealand dental students. *European Journal of Dental Education* 20: 135-141.

Ding, C., Foster Page, L.A. & Rangnekar, S.. (2015). Interprofessional Education, Dentistry, and the NZ Experience: A Commentary. *New Zealand Dental Journal*, 111(3):109-12.

Foster Page, L.A., Chen, V., Gibson B. & McMillan, J. (2016). Overcoming structural inequalities in oral health: The role of dental curricula. *Community Dental Health* 33:1-5.

Foster Page, L.A., Gray, L., Gallagher, P., McKinlay, E., & Rich, A.M. (2015). Untangling the web of influences on interprofessional education for dental students. *Journal of Dental Education* 80:677-685.

Golding, C., & Adam, L. (2016). Evaluate to improve: Useful approaches to student evaluation. *Assessment & Evaluation in Higher Education*, 41(1), 1-14.

Harris, R.C.L., Millichamp, C.J. & Thomson W.M. (2015). Stress and coping in fourth-year medical and dental students. *New Zealand Dental Journal* 111: 102-108

Kang, I., Foster Page, L.A., Anderson, V., Thomson W.M. & Broadbent, J.M. (2015). Changes in students' perceptions of their dental education environment. *European Journal of Dental Education* 19: 122-130

Lai, K.W. & Smith, L. Tertiary students' understandings and practices of informal learning. In press, *Australasian Journal of Educational Technology*.

Murray, C., Gray, A. & Chandler N.P. (2016). Eyesight: A study of dental surgery students during their clinical training. *Optometry in Practice* 17:113-120.

Murray, C. & Chandler, N.P. Final year dental students in New Zealand: Self-reported confidence levels prior to BDS graduation. In press, *New Zealand Dental Journal*.

Murray, C.M. & Chandler, N.P. (2015). Operative aspects of the undergraduate endodontic learning experience in New Zealand. *New Zealand Endodontic Journal* 49: 5-12.

Smith L., Adam, L., Meldrum, A., Moffatt, S. & Ahmadi, R. Undergraduate Bachelor of Oral Health student and educators' understandings of professionalism. In press, *New Zealand Dental Journal*.

Subramanian, J. & Thomson, W.M. The learning environment in professional doctorate and postgraduate dental education: A qualitative study. In press, *European Journal of Dental Education*.

## Conference presentations and abstracts

Adam, L., Spronken-Smith, R., & Anderson, V. (2015). Re-conceptualising plagiarism: Engaging students in quality scholarship. *Proceedings of the 12th Annual International Society for the Scholarship of Teaching and Learning (ISSOTL) Conference*. (pp. 58).

Adam, L., Anderson, V., & Spronken-Smith, R. (2015). Re-thinking plagiarism in light of a bigger question: What is the purpose of university education? *Proceedings of the Higher Education Research and Development Society of Australasia (HERDSA) Conference: Higher Education in a Globalized World*, Melbourne, Australia.

Ahmadi, R., Smith, L. & Adam, L. (2016). Undergraduate oral health students' and teachers' understandings of professionalism. *Proceedings of the College of Oral Health Academics 15th Annual Meeting*, Adelaide, South Australia.

Brunton, P.A., Ghazali, A., Tarif, Z.H. & Loch, C. (2016). Repair vs. replacement of direct composite restorations: a survey of teaching programs in Oceania. *IADR/AADR/CADR General Session & Exhibition*, San Francisco, USA.

Foster Page, L.A., Chen, V., Gibson, B. & McMillan J. (2016). Overcoming structural inequalities in oral health: the role of dental curricula. *General Assembly Session International Association of Dental Research*. Symposia presentation Seoul, Korea.

Friedlander, L.T., Chandler, N.P. & Daniel, B. (2016) Five year analysis of undergraduate education using tapered hand and rotary canal instrumentation techniques. *International Endodontic Journal* 49:85.

Chandler, N.P., Gray, A. & Murray C.M. (2015) Vision: a study of clinical dental teachers. *Journal of Dental Research* 94: Spec Iss C abstract 2315487

Murray, C.M., Gray A. & Chandler, N.P. (2015) Eyesight: a study of dental students during their clinical training. *Journal of Dental Research* 94: Spec Iss C abstract 2315463

Murray, C.M. & Chandler, N.P. (2015) Eyesight status of students commencing clinical practice: A survey. *Journal of Dental Research* 94: Spec Iss A abstract 2094008

Olson, H., Adam, L., Moffat, S., & Tawse-Smith, A. (2016). Perceived Stressors of Bachelor of Oral Health Students. *Proceedings of the College of Oral Health Academics 15th Annual Meeting*, Adelaide, South Australia.

## Student research

Ebbeling S, Adam, L, Meldrum A, Rich A. Barriers to Learning in the Clinical Environment: A Dental Students' Perspective (SJWRI Summer Studentship, 2015/16)

Fisher, C., Foster Page, L.A., Zeng, J., McMillan, J. & Lyons, K. Appraisal of a measure of social accountability in the dental educational environment (Honours project, 2016).

Garde, S., Tawse-Smith A. & Adam, L. Perceived stressors of undergraduate dental students at the University of Otago Faculty of Dentistry (Final year elective, 2015).

Ghazali, A., Tarif, Z., Brunton, P.A., & Loch, C. Repair vs. replacement of direct composite restorations: A survey of teaching and operative techniques in Oceania (Final year elective, 2016)

Koonne, T., Moru, P., Foster Page, L.A. Knowledge, attitudes and practices towards preventive dentistry among dental students (Final year elective, 2016).

# Dental Epidemiology and Public Health Research

Programme leader: Professor Murray Thomson

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 continues to play an important role in the development and epidemiological validation of self-report measures, working in collaboration with a number of overseas researchers. We are also one of only three WHO Collaborating Centres in oral health in our particular WHO region; the other two are in Niigata (Japan) and Beijing (China).

## Current research projects and focus areas

### 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

**Source(s) of funding:** NZ HRC, US NIH, Otago Medical Research Foundation

**Outcomes during 2015-16:** Work in this area continues to attract international attention and to be published in the top international journals: 8 papers were published, and a number of conference presentations were made. We completed the second 3 years of the 6-year HRC programme grant and obtained an HRC project grant for the age-45 assessments. The funded aims of the dental research component for age 38 were: (1) to document the natural history of oral health and disease from childhood through to early midlife; (2) to determine the nature of the relationship of those conditions and associated SES inequalities with antecedent characteristics and exposures; (3) to investigate the relation between chronic periodontitis and cardiovascular risk; and (4) to identify gene-by-environment associations in oral health and disease. The funded aims of the dental research component for age 45 are 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.



The Barningham building, former home of the Dunedin Multidisciplinary Health and Development Study, adjoining the west wing of the Walsh Building. Both were demolished in 2016 to make way for the new Clinical Services Building of the Faculty of Dentistry. As of late 2016 the Dunedin Study is based at Logan Park, while a new \$2.6M facility is built for the Study in Anzac Avenue near the University's premises at Forsyth Barr Stadium.



## Activity 2. Other dental epidemiological and clinical research

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

**Aims:** Various – enhancement of the knowledge base for dental epidemiology, dental public health, and clinical practice. An example is the International Collaborative Indigenous Health Research Partnership (ICIHRP) with Australia (University of Adelaide) and Canada (University of Toronto) investigating the oral health of Indigenous mothers and their infant children.

**Source(s) of funding:** Various – including NZ Ministry of Health, the International Collaborative Indigenous Health Research Partnership, NZDA Research Foundation, the Health Research Council of NZ, Dental Council of NZ.

**Outcomes during 2015-16:** 15 papers were published.

## 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 NZDA Research Foundation, the Health Research Council of NZ, Dental Council of NZ.

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

**Outcomes during 2015-16:** 24 papers were published (this total includes 6 dental educational research papers by our team which are included here because they do 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 2015-16:** successful postgraduate completions comprised 1 Doctor of Philosophy and 1 Doctor of Clinical Dentistry. We are currently supervising 2 Doctors of Philosophy, 7 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.

## Key personnel and collaborations

Professor WM Thomson

Professor JR Broughton

Associate Professor LA Foster Page

Dr JM Broadbent

Ms DM Shearer (funded by an HRC programme grant; working on oral-general health)

Our collaborations are very important to the work and impact of the group. Current collaborations include institutions in New Zealand (including Raukura O Hauora Tainui and the Waikato-Tainui College for Research and Development, Canterbury District Health Board), Australia (the Universities of Adelaide and Melbourne), Canada (The University of Toronto, McGill University), Japan (Osaka University), Malaysia (Universiti Malaya), the USA (Duke University, the University of Michigan and the University of North Carolina), Britain (GKT Dental Institute, the University of London, Sheffield University, Dundee University), Chile (University of Chile) and Brazil (Federal University of Pelotas and the University of Rio Grande do Sul).

## Research funding (over \$5,000)

2015. Ministry of Health Research Fund. *Exploring oral health care planning and service delivery models for dependent older adults in aged residential care facilities: feasibility and acceptability in the aged-care sector.* Smith MB, Thomson WM. (\$34,421).

2015. Health Research Council. Broadbent JM, Thomson WM, Moffitt TE, Caspi A, Poulton R. Oral health from childhood to mid-life. 2015-2020 (\$1,193,937).

2015. Maurice and Phyllis Paykel Trust. Broadbent JM, Thomson WM. A lifecourse study on chronic dental conditions and ageing of the teeth and dentition: equipment grant application. (\$12,500)

2016. New Zealand Dental Association Research Foundation. Broadbent JM, Thomson WM. A lifecourse study on chronic dental conditions and ageing of the teeth and dentition: equipment grant application. (\$13,500)

2016. Deckel Maho Gildermeister (DMG) Germany. *What are barriers and enablers for dentists to non-invasively manage proximal caries lesions?* Foster Page LA, Schwendicke F, Baker SR, Fontana M, Thomson WM. (\$32,000)

2016. Ministry of Health Research Fund. *Reading between the lines: how do young New Zealanders from lower socio-economic backgrounds feel about not getting their teeth straightened?* Foster Page LA, Antoun J, Jack H. (\$29,345)

2016. Ministry of Health Health Research Fund. *Pasifika adolescents' understandings and experiences of oral health care*. Smith L, Foster Page LA, Richards R. (\$36,097)

2016. Ministry of Health Research Fund. *Cognitive function, dependency and oral health among frail older New Zealanders: a national survey*. Thomson WM, Smith MB, Kerse NM, Ferguson CA. (\$37,789).

2016. University of Otago Research Grant. *I just want my teeth straightened*. Foster Page LA (PI), Antoun J, Jack H, Fowler P. (\$36,000).

## Key publications

In total, 47 papers were published in the peer-reviewed international scientific literature during 2015-16. The total number of conference presentations made was 41 (including 21 keynote addresses – see below for details).

## Key publications by researcher

### Dr JM Broadbent

Broadbent JM, Zeng J, Foster Page LA, Baker S, Ramrakha S, Thomson WM. Oral health-related beliefs, behaviours, and outcomes through the life course. *Journal of Dental Research*. (2016) doi: 10.1177/0022034516634663 (2016).

Broadbent JM, Theodore M, Te Morenga L, Thomson WM, Brunton P. Ethnic and socioeconomic inequalities in dental treatment at a school of dentistry. *New Zealand Dental Journal* 112: 55-61 (2016).

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### Professor JR Broughton

Broughton J.R., Lawrence, H.P., and Jamieson, L.M. Tikanga Māori (Māori Customary Practices) in Oral Health Research. *Journal of Health Care for the Poor and Underserved* 27: 101-109 (2016).

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### Associate Professor LA Foster Page

Foster Page LA, Chen V, Gibson B, McMillan J. Overcoming structural inequalities in oral health: the role of dental curricula. *Community Dental Health* 33:1-5 (2016).

Foster Page LA, L Gray, P Gallagher, E McKinlay, A M Rich. Untangling the web of influences on interprofessional education for dental students. *Journal of Dental Education* 80: 677-685 (2016).

Foster Page LA, Thomson WM, Beckett D, Cameron C. Can the Child Health Utility 9D measure be useful in oral health research? *International Journal of Paediatric Dentistry* 25: 349-357 (2015).

Schwendicke F, Dorfer C, Schlattmann P, Foster Page LA, Thomson WM, Paris S. Socioeconomic inequality and caries: A systematic review and meta-analysis. *Journal of Dental Research* 94: 10-18 (2015).



Master of Public Health student Deanna Beckett, supervised by A/Prof Lyndie Foster Page and Prof Murray Thomson, won the Oral Presentation Award for the Dental Epidemiology and Public Health session at the 2016 SJWRI Research Symposium.

## Ms DM Shearer

Shearer DM, Thomson WM, Mann J, Poulton R. Periodontitis is not associated with metabolic risk during the fourth decade of life. In press, *Journal of Clinical Periodontology*.

Shearer DM, Thomson WM, Broadbent JM, McLean R, Poulton R, Mann J. High-risk glycosylated hemoglobin trajectories established by mid-20s: findings from a birth cohort study. *BMJ Open Diabetes Res Care*.4(1):e000243 (2016). doi: 10.1136/bmjdr-2016-000243

## Professor WM Thomson

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Healey DL, Gauld RDC, Thomson WM. Treatment-associated changes in malocclusion and OHRQoL: a four-year cohort study. *American Journal of Orthodontics and Dentofacial Orthopedics* 150: 811-817 (2016).

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## Keynote addresses

Broughton, J.R. "Taku hikoi ki hauora Māori: My journey through Māori health." Invited speaker at the Hui-A-Tau (Annual Conference) of Te Ohu Rata O Aotearoa, the Māori Medical Practitioners' Association, Papakura Marae, 24 September 2016.

Broughton, J.R. "Dentistry at the Normandy Invasion, World War II." Invited opening address at the University of Otago Sir John Walsh Research Institute Research Day, Dunedin Public Art Gallery, Dunedin, 1 September 2016.

Broughton, J.R. "A timely toothache in World War II." Invited opening address at the International Association for Dental Research, Australia and New Zealand Division Conference, Dunedin, 24 August 2015.

Broughton, J.R. "Special Operations In Dentistry." Invited opening address at the University of Otago Sir John Walsh Research Institute Research Day, Dunedin Public Art Gallery, Dunedin, 9 July 2015.

Broughton, J.R. "Ma te huruhuru te manu ka rere. With feathers a bird can fly," Invited opening address at the Dunedin Writers and Readers Festival, Regent Theatre, Dunedin, 7 May 2015.

Broughton, J.R. "Oranga Niho @ Otago" Invited opening address, Hui-a-Tau (Annual Conference), Te Ao Mārama, New Zealand Māori Dental Association, Dunedin, 17 April 2015.

Foster Page LA. *Child self-reported questionnaires in oral health research and service evaluation: what are they and do we need them?* Keynote address to the 25th Congress (biennial conference) of the International Association for Paediatric Dentistry, Glasgow, Scotland, 3 July 2015.

Thomson WM. *What can the findings of life-course research tell us about the challenges in promoting oral health through life.* Presented to the 70th Anniversary Celebration of Shanghai Stomatological Hospital, Fudan University, Shanghai, China, 25 October, 2016.

Thomson WM. *Reflections on a quarter century of research in DPH.* Keynote address to the 2016 conference of the New Zealand Society of Hospital and Community Dentistry, New Plymouth, 29 July 2016.


Thomson WM. *Beware of the fashionable: Keeping it real in oral epidemiological research.* Keynote address to the 7th International Meeting on Methodological Issues in Oral Health Research, Bergen, Norway, 13 May 2016.

Thomson WM. Two keynote addresses (*Writing a paper – what to do and what not to do and Navigating the publication process*) to the annual conference of the Indian Association of Public Health Dentistry, Manipal, India, 20 November 2015.

Thomson WM. Two keynote addresses (*Dry mouth and The Dunedin Study*) to the 47th Semana Academica de Odontologia at Universidade Federal Rio Grande Do Sul, Porto Alegre, Brazil, 8 and 9 October 2015.

Thomson WM. *The oral health of older people: what we know and what we should know.* Keynote address to the Annual Scientific Meeting, National Dental Centre Singapore, Singapore, 29 August 2015.

Thomson WM. (1) *Gerodontology research: issues, opportunities and challenges.* (2) *The Dunedin Study: documenting the natural history of oral health and disease through life.* (3) *Periodontitis in adults: natural history, antecedents and impact.* Keynote addresses to the Research Day conference, National Dental Centre Singapore, Singapore, 28 August 2015.



Thomson WM. *New Zealand's ageing population and "teeth for life": be careful what you wish for...* Keynote address to the New Zealand Dental Association biennial conference, Auckland, 20 August 2015.

Thomson WM. *Psychosocial aspects of paediatric dental GA*. Keynote address to the 25th Congress (biennial conference) of the International Association for Paediatric Dentistry, Glasgow, Scotland, 4 July 2015.

Thomson WM. *Insights from 25 years of gerodentological research*. Keynote address to the Geriatric Oral Research Group at the 93rd General Session of the International Association for Dental Research, Boston, USA, 13 March 2015.

## Honours and awards

**Professor Broughton** was made a Companion of the New Zealand Order of Merit for services to Māori Health, theatre and the community. Queen's Birthday Honours, June 2016

**Professor Broughton** received the Dr Maarire Goodall Award, honouring service by Māori health professionals to Māori communities for Māori health development, by Te Ohu Rata O Aotearoa, New Zealand Māori Medical Practitioners Association, 24 September 2016.

**Dr Shearer** received the 2015 IADR Colgate Research in Prevention Travel Award

**Dr Broadbent** received the 2015 Investigator Award for Excellence in Preventive and Community Dentistry Research from the International Association of Dental Research Australia New Zealand Division.

**Dr Broadbent** received the 2015 Award for Basic Research, University of Otago Sir John Walsh Research Institute.

**Associate Professor Foster Page** was awarded a Fulbright travel Grant in 2015.

## Editorial positions

Professor Thomson assumed the Editor-in-Chief position for *Community Dentistry and Oral Epidemiology* in January 2015. He also remains as Associate Editor for the *European Journal of Oral Sciences*.

Associate Professor Foster Page was appointed as Section Editor for *BMC Oral Health*, and to the Editorial Advisory Board for *Community Dentistry and Oral Epidemiology* (3-year term).

## Postgraduate student completions 2015-16

Doctor of Philosophy: Dara Shearer. *Longitudinal associations between periodontal disease and glycaemic control* (Supervisors: WM Thomson, J Mann, R Poulton). Completed February 2016.

Doctor of Clinical Dentistry: Azza Al-Ani. *Genetics of hypodontia* (Supervisors: M Farella, JS Antoun, A Merriman, WM Thomson). Completed November 2016.

# Molecular Microbiology Programme

Programme leader: Geoffrey Tompkins

Molecular Microbiology research within the SJWRI encompasses microbiological investigations applied to a variety of disciplines including endodontics, periodontics and implantology, cariology and treatment with antimicrobials, antifungal drug development, microbial genomics and forensics.

Major funding supporting research within the Theme during 2014-2016 came from the Marsden Fund (Royal Society of New Zealand), University of Otago Research Committee, New Zealand Dental Research Foundation, Ministry of Health Oral Health Research Fund, New Zealand Health Research Council, Maurice and Phyllis Paykel Trust, the Fuller Scholarship, Otago Innovation Ltd., Dentsply, Syngenta and other industrial concerns.

## Personnel

### Faculty and Staff

Associate Professor Vincent Bennani  
Professor Richard Cannon  
Dr Peter Cathro  
Professor Mauro Farella  
Dr Nick Heng  
Dr Ann Holmes  
Dr Mikhail Keniya  
Dr Erwin Lamping  
Dr Hee Ji Lee  
Associate Professor Jonathan Leichter  
Professor Karl Lyons  
Dr Li Mei  
Associate Professor Brian Monk  
Dr Don Schwass  
Dr Andrew Tawse-Smith  
Associate Professor Geoffrey Tompkins  
Dr Rajni Wilson  
Dr Mathew Woods

### Postgraduate Students

Peter Cathro (PhD; graduated 2016)  
Gemma Cotton (PhD)  
Sarah Davies (PhD; graduated 2016)  
Golnoush Madani (PhD)  
Bikiran Pardesi (PhD; graduated 2015)  
Alia Sagatova (PhD; graduated 2016)  
Syarida Safii (PhD)  
Amira Salem (PhD)  
Don Schwass (PhD)  
Josh Dunn (MSc)  
Shreya Aggarwala (DCLinDent; graduated 2016)  
Gareth Benic (DCLinDent; graduated 2016)

James Dawson (DCLinDent; graduated 2016)  
Arpana Devi (DCLinDent; graduated 2016)  
Siddhanta Dhruvad (DCLinDent; graduated 2016)  
Nivea Kamalendran (DCLinDent; graduated 2015)  
Lydia Meredith (DCLinDent; graduated 2015)



DCLinDent student Gareth Benic was the winner of the Best Oral Presentation Award in the Molecular Microbiology session of the 2016 SJWRI Research Symposium.

### Summer students and Honours Students

Nancy Chen (BDS summer student, 2015)  
Nicholas Choo (BDS summer student, 2014)  
Danyon Graham (BDS summer student 2014, 2015)  
Harith Hassan (BDS summer student, 2015)  
Chuen Lin Hong (BDS summer student, 2015)  
Allen Hu (BDS Honours, 2016)  
Kenny Kim (BDS honours, 2015)  
Joanne Lee (BDS summer student, 2014)  
Fay Yan (BDS summer student, 2015)

## Visiting Scientists and students

Dr Mohammed Alqumber, Albaha University, Saudi Arabia

Dr Francesca Fabiano, University of Messina, Messina, Italy

Camille Herhusky, University of California at Berkeley, San Francisco, USA

## Extramural Collaborators

Dr Stewart Bisset, AgResearch, Palmerston North

Dr Ariya Chindamporn, Chulalongkorn University, Bangkok, Thailand

Dr Edmund Fleischer, MicroCombiChem, Weisbaden, Germany

Dr Anette Klinger, MicroCombiChem, Weisbaden, Germany

Dr Michael Gottesman, National Cancer Institute, NIH, Bethesda, USA

Professor Susumu Kajiwara, Tokyo Institute of Technology, Tokyo, Japan

Dr Kurt Lackovic, Walter and Eliza Hall Institute, Melbourne, Australia

Associate Professor Alok Mitra, Auckland University, Auckland

Professor Rajendra Prasad, Jawaharlal Nehru University, New Delhi, India

Dr Jan Schmid, Massey University, Palmerston North

Professor Larry Sklar, University of New Mexico, Albuquerque, USA

Professor Robert Stroud, UCSF, San Francisco, USA

Dr Thomas Tomasiak, UCSF, San Francisco, USA

Dr Silas Villas-Bôas University of Auckland, Auckland

Associate Professor Maggie-Lee Huckabee, University of Canterbury, Christchurch

Associate Professor Marina Bakri, Malaysia, University of Malaya, Kuala Lumpur

Professor Pete Magee, University of Minnesota, Minneapolis, USA

Dr Masakazu Niimi, Chulalongkorn University, Bangkok, Thailand

Professor Amarila Malik, Universitas Indonesia, Depok, Indonesia

Associate Professor Koshy Philip, Universiti Malaya, Kuala Lumpur, Malaysia

## Current research

### Structure-directed antimicrobial discovery

**Principal Investigator:** Brian Monk

### Structure-directed discovery of next-generation antifungals

There is a paucity of structural information on existing antifungal targets and there is an emerging problem of antifungal resistance that affects both medicine and agriculture. These problems are being addressed by overexpressing in yeast the azole drug target lanosterol 14 $\alpha$ -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 superfamily. 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 25 crystal structures of wild type and mutant lanosterol 14 $\alpha$ -demethylase from *Saccharomyces cerevisiae* in complex with a range of azole drugs and agrochemicals plus the first crystal structure of a full-length lanosterol 14 $\alpha$ -demethylase from a fungal pathogen (*Candida glabrata*). This information, together with our recent determination of the crystal structure of *Candida albicans* lanosterol 14 $\alpha$ -demethylase, is being used to design chimeric antifungals that combined the best attributes of existing antifungals and has enabled computer-based screens of large compound libraries in efforts to discover novel antifungals.

The group published 6 papers in the 2015-2016, with an additional research paper and a book chapter review in press. The group completed a Marsden Fund grant (2010-2015), a 2 year research collaboration with the agrochemical company Bayer AG (2014-2016) and a Health Research Council of New Zealand grant (2013-2016) that led to the award of a further Health Research Council grant (2016-2019) entitled "Structure-directed discovery of next-generation antifungals". In 2016 Associate Professor Monk was also awarded a grant from Lotteries Health Research to purchase an advanced HPLC machine used for protein purification. Research collaborations involve Associate Professor Joel Tyndall in the New Zealand's National School of Pharmacy, the laboratory of Professor Robert Stroud at UCSF (San Francisco), the combinatorial chemistry company MicroCombiChem (Weisbaden, Germany) and Bayer AG Crop Protection Division (Monheim, Germany and Lyon, France). PhD student Alia Sagatova and DClinDent students Shreya Aggarwala and

Arpana Devi completed their studies in 2016, with Alia awarded a Thomas Kay Sidey postdoctoral fellowship. Summer student Danyon Graham won the 2015 junior poster competition at the IADR conference in Dunedin and the Otago Medical Research Foundation summer student speaker competition in 2016.

## *Candida* adherence and drug-resistance

**Principal investigator:** Richard Cannon

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 importance. The main cause of high-level azole drug resistance in the most common oral fungal pathogen, *Candida albicans*, is over-expression of ATP-binding cassette (ABC) membrane proteins that efflux the drugs from cells. We have used our patented *Saccharomyces cerevisiae* system for heterologously expressing membrane proteins to study *C. albicans* efflux pump Cdr1 function. 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 utilis* and *Penicillium marneffeii*.

*C. albicans* is a diploid fungus that can mate but does so infrequently. By studying the growth rates of fusants formed *in vitro* and the survival of fusants *in vivo* we found that mating generates genotypes superior to existing strains often enough to be under slight positive selection.

In 2014-2015, this research was funded from the following sources: the Marsden Fund of the Royal Society of New Zealand, the Maurice and Phyllis Paykel Trust, the New Zealand Dental Association Research Foundation, and the University of Otago Research Committee.

## Oral Bacteriology

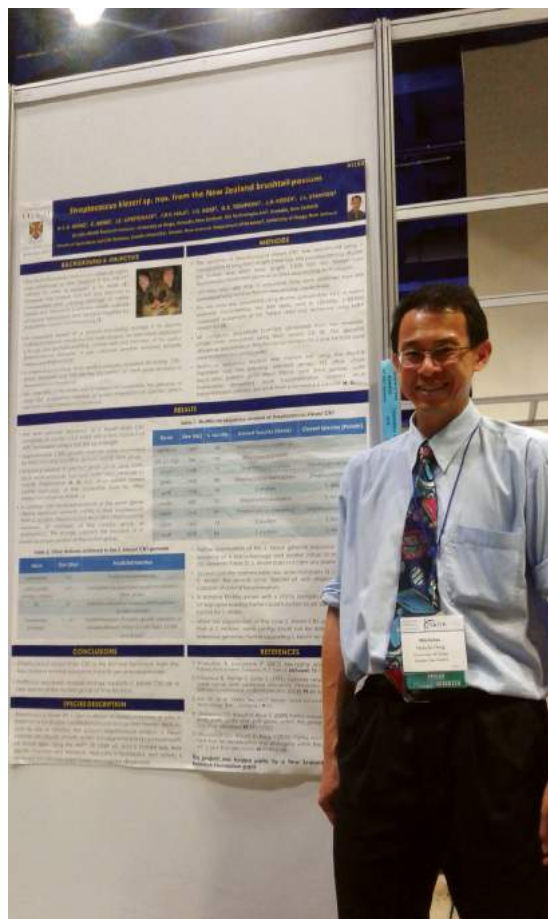
**Principal investigator:** Geoffrey Tompkins

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) investigation into how periodontal bacteria acquire heme; (iv) the involvement of dental plaque bacteria in the development of aspiration pneumonia in stroke patients; (v) the effect of various antimicrobials, including chlorhexidine, manuka honey and silver-based antimicrobials affect oral microbial ecology.

## Microbial profiling and bacterial 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.



Dr Nick Heng presenting his research at the 2016 IADR General Session in Seoul.

## 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.

**Other research programmes** undertaken within the Molecular Microbiology Theme overlap with and are described in respective staff members' profiles elsewhere in this volume.

## Highlights

### Research Prizes

Alia Sagatova : Thomas Kaye Sidey postdoctoral fellowship (2016)

Danyon Graham: Junior poster competition at the IADR conference (Dunedin, 2015); Otago Medical Research Foundation summer student speaker competition (2016).

Gareth Benic, Sir John Walsh Research Institute Research Symposium Oral Presentation prize

Chuen Lin Hong, IADR NZ Section poster prize and IADR ANZ Division Colgate poster prize

Joanne Lee, IADR NZ Section poster prize

### Notable Publications

Aung, H. L., Samaranayaka, C. U. K., Enright, R., Beggs, K. T., & Monk, B. C. (2015). Characterisation of the DNA gyrase from the thermophilic eubacterium *Thermus thermophilus*. *Protein Expression & Purification*, 107, 62-67. doi: 10.1016/j.pep.2014.11.009

Bennani, V., Hwang, L., Tawse-Smith, A., Dias, G. J., & Cannon, R. D. (2015). Effect of air-polishing on titanium surfaces, biofilm removal, and biocompatibility: A pilot study. *BioMed Research International*, 2015, 491047. doi: 10.1155/2015/491047

Holmes, A.R., Cardno, T.S., Strouse, J.J., Ivnitski-Steele, I., Keniya, M.V., Lackovic, K., Monk, B.C., Sklar, L.A. & Cannon, R.D. (2016) Targeting efflux pumps to overcome antifungal drug resistance. *Future Medicinal Chemistry*. 8(12):1485-501. doi: 10.4155/fmc-2016-0050

Keniya, M. V., Fleischer, E., Klinger, A., Cannon, R. D., & Monk, B. C. (2015). Inhibitors of the *Candida albicans* Major Facilitator Superfamily transporter Mdr1p responsible for fluconazole resistance. *PLoS ONE*, e0126350. doi: 10.1371/journal.pone.0126350

Knight, E. T., Leichter, J. W., Tawse-Smith, A., & Thomson, W. M. (2015). Quantifying the association between self-reported diabetes and periodontitis in the New Zealand population. *Journal of Periodontology*, 86(8), 945-954. doi: 10.1902/jop.2015.150048

Malik, A., Sumayyah, S., Yeh, C.W. and Heng, N.C.K. (2016) Identification and sequence analysis of pWcMBF8-1, a bacteriocin-encoding plasmid from the lactic acid bacterium *Weissella confusa*. *FEMS Microbiology Letters* 363(8): pii: fnw059. doi: 10.1093/femsle/fnw059. Epub 2016 Mar 13.

Pardesi B. and Tompkins. G.R. (2014) Colony polymerase chain reaction of heme-accumulating bacteria. *Anaerobe* 32C 49-50.

Rawal, M.K., Banerjee, A., Shah, A.H., Khan, M.F., Sen, S., Saxena, A.K., Monk, B.C., Cannon, R.D., Bhatnagar, R., Mondal, A.K. & Prasad, R. (2016) Newly identified motifs in *Candida albicans* Cdr1 protein nucleotide binding domains are pleiotropic drug resistance subfamily-specific and functionally asymmetric. *Scientific Reports*. 6:27132. doi: 10.1038/srep27132

Sagatova, A., Keniya, M. V., Wilson, R. K., Monk, B. C., & Tyndall, J. D. A. (2015). Structural insights into binding of the antifungal drug fluconazole to *Saccharomyces cerevisiae* lanosterol 14 $\alpha$ -demethylase. *Antimicrobial Agents & Chemotherapy*. Advance online publication. doi: 10.1128/aac.00925-15

Sagatova, A.A., Keniya, M.V., Wilson, R.K., Sabherwal, M., Tyndall, J.D.A. & Monk, B.C. (2016) Triazole resistance mediated by mutations of a conserved active site tyrosine in fungal lanosterol 14 $\alpha$ -demethylase. *Scientific Reports*. 6:26213. doi: 10.1038/srep26213

Seymour, G.J., Cullinan, M.P. and Heng, N.C.K. (2016) Oral Biology: Molecular Techniques and Applications, Second Edition. *Methods in Molecular Biology*, volume 1537.

Tawse-Smith, A., Atieh, M. A., Tompkins, G., Duncan, W. J., Reid, M. R., & Stirling, C. H. (2015). The effect of piezoelectric ultrasonic instrumentation on titanium discs: A microscopy and trace elemental analysis in vitro study. *International Journal of Dental Hygiene*. Advance online publication. doi: 10.1111/idh.12142

Walker, G.V., Heng, N.C.K., Carne, A., Tagg, J.R. and Wescombe, P.A. (2016) Salivaricin E and abundant dextranase activity may contribute to the anti-cariogenic potential of the probiotic candidate *Streptococcus salivarius* JH. *Microbiology* 162:476-486

Wong S, Mundy L, Chandler N, Upritchard J, Purton D, Tompkins G. Antibacterial properties of root canal lubricants. *Aust. Endodont. J.* 40(3) 111-115 (2014).

Zhang, N., Magee, B.B., Magee, P.T., Holland, B.R., Rodrigues, E., Holmes, A.R., Cannon, R.D. and Schmid, J. (2015) Selective advantages of a parasexual cycle for the yeast *Candida albicans*. *Genetics* 200:1117-1132



# Oral Molecular and Immunopathology

Programme Leader: Professor Alison Rich

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 with respect to local and nodal immune regulation, influences on local invasion, angiogenesis and the reaction to endoplasmic stress and epigenetic effects. The interest in angiogenesis extends to pulpal tissues in terms of continued root development following pulp injury, as well as to the effect of bisphosphonates and the pathogenesis of bisphosphonate related osteonecrosis of the Jaw (BRONJ). Cell lines have been developed from pulp and periosteum to gather information on the presence of progenitor cells in these tissues.

## Key Personnel and Collaborations

### Staff

Dawn Coates	Lara Friedlander
Lynda Horne	Haizal Hussaini
Ramya Jawadi	Jae-Kwang Jung
Sharla Kennedy	Trudy Milne
Praveen Parachuru	Alison Rich
Benedict Seo	

### PhD and DClindent students

Nawal Abdul Rahman	Muhammad Al-Ansary
Adil Al Kharusi	Shaikha Al Samahi
Avadhoot Avadhani	Kullasit Chutipongpisit
Fiona Firth	Nurul Ibrahim
Hina Narayan	Hitesh Navani
Elizabeth Williams	Muhammed Yakin

We have international collaborative studies with the Oral Cancer Research and Coordinating Centre, University of Malaya ([malaysiaoralcancer.org](http://malaysiaoralcancer.org)) Malaysia and the Kyoungpook National University, Korea.

## Current Research Projects

### Activity 1. Angiogenesis

#### Angiogenesis and pulp biology

Angiogenesis is upregulated in the presence of inflammation and may be altered following *in vitro* induced mechanical pulp cell injury. It is unclear if pulp inflammation arising from dental caries results in altered angiogenic expression in the apical papilla. This *in vitro* study is investigating the expression of angiogenic factors in the apical papilla obtained from immature permanent teeth with healthy and inflamed pulps arising from caries. Immunohistochemistry (IHC) of the apical papilla will be performed to assess the presence of various angiogenic factors along with analysis of gene expression with a custom-made array. Knowledge of angiogenic signalling in health and disease will improve understanding around the potential for healing following pulp injury in teeth with incomplete root development.

#### 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. Several inflammatory cells and mediators are known to be important in the pathogenesis of diabetes and diabetes-related disorders including toll-like receptors (TLRs), interleukin-17 (IL-17) and regulatory T cells (Tregs). There is an established relationship between diabetes and periodontal disease but the relationship between diabetes and health of the dental pulp is unclear. T2D frequently results in poor pulp healing and subsequent pathology, but laboratory studies are required to understand why. TLR2 and TLR4 protect against bacteria entering the pulp and Tregs have been implicated but little is known about IL-17 expression in the dental pulp. The influence of T2D on these markers is unknown and enquiry around this forms the basis of this study.

#### Angiogenesis in inflammatory hyperplasias

Disturbance of angiogenic regulation is a feature of some reactive hyperplastic responses such as pyogenic granulomas (PG) which usually present intra-orally as a vascular gingival mass. The increased vascularity of PG is due to over-expression of vascular endothelial growth factors (VEGF) and fibroblast growth factor (FGF)-2 and under-expression of angiostatin, an angiogenesis inhibitor. PGs are non-neoplastic vascular oral lesions which can grow rapidly in the presence of stimulating factors including hormone imbalance and trauma, but are reversible unlike oral squamous cell carcinoma (OSCC). This study involves IHC and analysis of genes related to angiogenesis in PG in comparison with OSCC.

### Angiogenesis and oral squamous cell carcinoma

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.

### 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 recently discovered 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. Evidence suggests that UPR components are activated to either inhibit cancer growth or promote its progression. UPR activation in cancer cells may result in protective responses including cell death with resolution of the disease or the cessation of protein production leading to lesion dormancy. Alternatively, it may result in responses that promote cancer growth and progression including the activation of pathways that protect against cell death and the formation of new blood vessels within the cancer tissue. In this project we are examining the differential expression of key UPR protein markers in OSCC, potentially malignant mucosa, and normal oral mucosa in order elucidate the role that ER stress plays in the development and prognosis of OSCC.

### 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 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 periodontal diseases

The close relationship between the Th cell subsets, Tregs and Th17, and their contrasting role in influencing the immune response has led to the hypothesis that both FOXP3+Tregs and (IL17+Th17) cells influence the immune response in diseased periodontal tissues. The aim of this study therefore was to determine the presence of FOXP3+ Tregs and IL17+ cells and their possible spatial interaction in diseased periodontal tissues. The results suggest that FOXP3+ cells may have a more prominent role in periodontal disease processes when compared with IL17+ cells.

### 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 squamous cell carcinoma-IL17 and invasion

Interleukin (IL)17 is a pro-inflammatory cytokine with increased gene expression in some cancers. It has been demonstrated to exhibit both pro- and anti-tumour effects. The pro-tumour effects of IL17 are mediated either by inducing the expression of matrix metalloproteinases (MMPs) in tumour cells or stimulating increased tumour angiogenesis. The anti-tumour effects of IL17 are exerted either through increased cytotoxic T (Tc) cell or interferon (IFN) $\gamma$  activity. In this study it was found that IL17 is co-expressed by multiple cell types in OSCC and it facilitated tumour progression by differential expression of genes associated with tumour metastasis, particularly those associated with extracellular matrix proteins and regulation of apoptosis.

### 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. 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. Epigenetics

### In periodontal diseases

Tobacco smoking, a significant risk factor for periodontal diseases, may cause epigenetic changes in cells which can lead to gene silencing. Epigenetic changes refer to variations in gene expression or cellular phenotype caused by mechanisms other than changes in the DNA sequence. In this project, we investigated the dose-dependent effect of cigarette smoke condensate (CSC) on the DNA methylation status of genes involved in the transforming growth factor (TGF)- $\beta$  signaling pathway in human gingival fibroblasts.

### In squamous cell carcinoma

In this project we investigated the dose-dependent effect of CSC on the DNA methylation status of genes involved in the TGF- $\beta$  signaling pathway in human oral epithelial cells. The results of our experiments may lead to the development of tools whereby differentially methylated genes may be used to assess tobacco exposure, disease progression and/or monitor treatment outcome; for both to prevent the occurrence of tobacco-related diseases and reduce their morbidity and mortality.

## Highlights 2015 and 2016

### Funding successes

*Expression of the lysyl oxidase family in benign odontogenic tumours.* N Abdul Rahman, BL Seo, AM Rich. Funding: New Zealand Dental Association Research Foundation Grant 2016-2018. \$9,442.

*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.

*The expression of STAT3 signalling pathway proteins in oral squamous cell carcinoma tissue.* M Yakin, BL Seo, AM Rich. New Zealand Dental Association Research Foundation Grant 2016-2017. \$2,503.

*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.

*An ABI qPCR machine for Oral Health Research.* D Coates, R Cannon, T Milne, AM Rich. New Zealand Dental Association Research Foundation Grant 2015. \$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- $\beta$  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.

### Publications

In 2015 and 2016 members of the group published 13 papers in international peer-reviewed journals. Nine conference proceedings were published and there were numerous presentations from members of the group including invited keynote presentations by Dr Haizal Hussaini at the FDI World Dental Federation meeting in Colombo, Sri Lanka in 2015 and by Professor Alison Rich at the Oral Disease Update meeting, Oral Cancer Research and Co-ordinating Centre, Kuala Lumpur, Malaysia in 2015. Full details of the publications are available online.

### Honours and Awards

2015: Alison Rich awarded Fellowship of the New Zealand Society of Pathologists.

2015: Alison Rich awarded Fellowship of Royal College of Pathologists on the basis of published works.

2016: Dawn Coates received the Sir John Walsh Research Institute Research Excellence Award for excellence in research over an extended period of time.

2016: Alison Rich nominated as the Sir John Walsh Research Institute Supervisor of the Year.

2016: Muhammed Yakin awarded the 'best oral presenter' award in the Oral Molecular and Immunopathology Programme of the Sir John Walsh Research Institute Symposium.

2016: Kullasit Chutipongpisit awarded a Travel Grant by the International Association of Oral Pathologists to present his research at the biennial meeting in Chennai.

2016: Muhammed Yakin awarded a Travel Grant by the International Association of Oral Pathologists to present his research at the biennial meeting in Chennai.

2016: Yinang Zhang, BDS4, awarded an Undergraduate Scholarship in Pathology from the Royal College of Pathologists of Australasia.

2016: Yinang Zhang, BDS4 awarded a Division of Health Sciences Summer Scholarship for 2016/7.

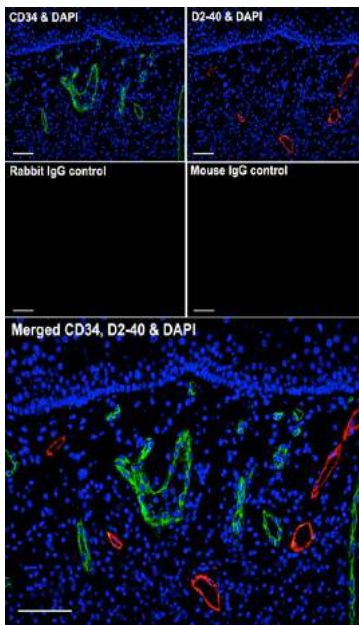
### Postgraduate Student Completions

Avadhoot Avadhani (PhD, 2015)

Diogo Zaniccotti (PhD, 2015)

Muhammed Yakin (DCLinDent Oral Pathology, 2016)

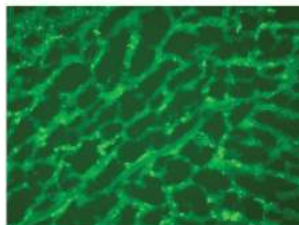
Kullasit Chutipongpisit (DCLinDent Oral Pathology, 2016)



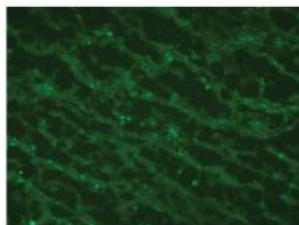
Double-labelling immunofluorescence showing D2-40+ lymphatic vessels (red) and CD34+ blood vessels (green) in oral squamous cell carcinoma from Kullasit Chutipongpisit's project.

## Day 4

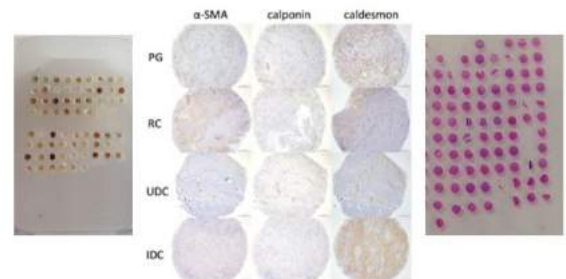
A: Hanks<sup>†</sup>



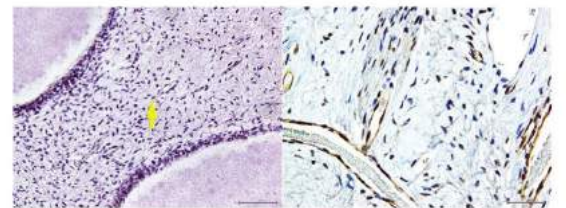
B: Saline



Direct immunofluorescence photomicrographs of rat spleen stained for IgA stored in either Hanks solution (Fig. 2a) or saline (Fig.2b) for four days. This was from a BDS elective study supervised by Dr Haizal Hussani investigating the suitability of various media for transporting fresh specimens sent from clinicians to the Oral Pathology Centre for diagnosis.



Tissue microarrays from work being undertaken by Muhammed Yakin and Dr Benedict Seo. Left to right: Paraffin-embedded wax block containing numerous tissue cores derived from odontogenic cysts, immunohistochemistry performed on the TMA, representative H&E staining.



H&E stained section of a decalcified tooth showing vital dental pulp with odontoblasts lining the dentine (left) and immunohistochemistry showing positive reaction of the endothelial cells (arrow) with Tie-2 (a receptor for angiopoietins). This is part of the DCLinDent project of Hitesh Navani, supervised by Dr Lara Friedlander.



Members of the Oral Molecular and Immunopathology Programme (2016).



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