



**SIR JOHN WALSH  
RESEARCH INSTITUTE**  
2011 – 2012

# Research Highlights

# Sir John Walsh Research Institute

The Sir John Walsh Research Institute, a Research Centre of the University of Otago, advances research and increases knowledge for the improvement of oral health in New Zealand. Its innovative, future-focused, interconnected research programmes cover the spectrum of oral health research, from the molecular level through biological systems to the health of populations. The Institute is part of New Zealand's only Faculty of Dentistry and its members have well-established productive collaborations across the University and with other institutions in New Zealand and worldwide. Among its research objectives is to develop clinical research that translates discoveries into measurable health improvements, and to maintain fundamental research that underpins teaching.

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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 2011-12. If you would like more detail, our full *Research Report of the Sir John Walsh Research Institute* is to be released in September 2013, including individual research profiles for all SJWRI staff members, and full listings of all SJWRI publications and research funding for the 2011-12 period. Alternatively, details on research programmes, activities and outputs are available from our website <http://sjwri.otago.ac.nz>, and individual research profiles are accessible through the University of Otago Division of Health Sciences' Research Expertise database, which is searchable: <http://www.otago.ac.nz/healthsciences/expertise/>.

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## Introduction from the Dean



It is an honour to write this introduction to the Research Highlights of the Sir John Walsh Research Institute. The Institute within the Faculty of Dentistry at the University of Otago has now established itself as providing the research basis for all the professions of dentistry within New Zealand. Within this reporting period, the results of the latest Performance Based Research Funding (PBRF) round were released, the Institute became a recognised Research Centre of the University and a new Clinical Research Programme was established so as to reflect the growing clinical research effort within the Faculty.

The PBRF results were particularly impressive with Dentistry outperforming a number of the basic science departments within the Health Sciences and with eight A ranked staff, Dentistry was the sixth highest out of all academic units within the University. This magnificent effort is a reflection of the activity within the Institute and is a testimony to the changed ethos that the creation of the Institute has brought to research within the Faculty and to the hard work of the Director in assisting staff with their Evidence Portfolios.

The position of the Institute as the focus for dental research in New Zealand was further recognised by the University by making the Institute a Research Centre of the University of Otago. Relatively few groups were given such recognition and the fact that the Institute was recognised as such reflects the high standing of dental research and of dental researchers, not only within the University, but also nationally and internationally.

The Institute draws together the research strengths within the Faculty. Initially there were five Research Programmes – Biomechanics and Oral Implantology (including Dental Biomaterials, Oral Implantology and Forensic Dentistry), Dental Epidemiology and Public Health, Oral Molecular and Immunopathology, Molecular Microbiology and Dental Education Research. The structure of the Institute however, was always designed to be flexible and while these five programmes represented the research strengths which existed at the time the Institute was formed, they were not fixed and it was envisaged that new programmes would evolve as new research themes developed and as the needs of the professions, and of the country, changed. In this context therefore, it is very pleasing to see the creation of the new Clinical Research Programme within the Institute.

The Clinical Research Programme, headed by Associate Professor Mary Cullinan, was formed in late 2012. It aims to bring together clinical researchers and to foster clinical research within the school. An early initiative of this group is to establish a practice-based research network (PBRN), which will reach out to dental practitioners throughout New Zealand. PBRNs foster relationships between practitioners and academics by investigating research questions of relevance to daily clinical practice. The types of studies that are undertaken range from retrospective studies using dental records, observational studies of routine care, case-control studies, through to clinical trials. Discussions have already been held with Dr Frederick Curro of New York University regarding the NZ PBRN linking with NYU's PEARL Network (Practitioners Engaged in Applied Research and Learning) together with eVident in Australia and the Scottish PBRN, based in Dundee, with the view of forming a global network to carry out practice based clinical trials.

The future of the Sir John Walsh Research Institute now looks very bright such that the oral health, and hence general health, of all New Zealanders will be based on a firm research footing.

I congratulate Professor Jules Kieser and all those involved in the Institute on their achievements thus far and I wish them all the best for the future.

**Gregory J Seymour** AM FRSNZ  
Dean, Faculty of Dentistry, University of Otago  
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## Report from the Director



As the only Faculty of Dentistry in New Zealand, we have been at the centre of dental research in this country for more than a century. Today, our staff and students continue to earn international acclaim in areas as diverse as immunopathology, oral implantology, dental public health, materials science, microbiology and forensic odontology, to name just a few. More than ever before, our researchers are collaborating beyond their traditional disciplinary boundaries and are sharing their expertise, experience and passion for discovery. This is evidenced by the hugely successful performance of the Faculty of Dentistry and its research arm, the Sir John Walsh Research Institute (SJWRI), in the recent Performance Based Research Fund round.

The Sir John Walsh Research Institute remains committed to supporting research excellence within the Faculty of Dentistry. However, building a successful research strategy depends on an understanding what is happening now and what we think future trends will be across the wider research landscape. With the highly advanced technology available today such research is becoming increasingly more collaborative, interactive and dynamic. Moreover, the complexity of today's research questions demands a move beyond the confines of our own disciplines and an exploration of complementary expertise from scholars in other fields. One example of our efforts in this context is the establishment of a new Research Programme, that of Clinical Research and in particular Practice-Based Research. Greatly facilitated by the University, who conferred the status of Research Centre to the SJWRI, we were able to establish this developing theme in addition to our five established areas of Research Strength (Biomechanics and Oral Implantology, Dental Epidemiology and Public Health, Education Research, Molecular Microbiology and Oral Molecular and Immunopathology). It should be emphasized, however, that while these themes are neither prescriptive nor exhaustive, they do offer current and future staff and students an insight into our established areas of research expertise.

Building a successful research strategy clearly also involves funding considerations. The current funding environment is becoming ever more competitive and complex. Hence, the resources to support our research and innovation now need to be derived from a multitude of sources and programs, including those of various levels of government as well as private sector partners and various not-for-profit agencies.

Additionally, there is an increasing political and financial investment in the idea of research as an economic driver. As the SJWRI is still largely dependent on competitive funding, it remains a challenge to create a sustainable resource base from all our funding sources. In a period of constrained public expenditure and reduced core funding for basic research, universities are understandably eager to present evidence of linkages between research and industry, as well as the larger goals of society. Our answer to these challenges has been to explore more vigorously the commercial application of many of our research ideas. However, we do recognize that approaches to solving such problems are not possible without a strong foundation in basic research, even if the linkages between innovation and such research appear to be indirect.

Much of the research conducted at the SJWRI depends on the involvement of both undergraduate and postgraduate students. Although the roles of students vary among research areas, the quality of the research that can be accomplished is frequently dependent on the calibre of the students conducting the research, as well as the support provided to them to enable their success. The greatest challenge for us is our outdated and overcrowded laboratory space. At all levels, the overall level of research improves as the number and quality of staff and students improves. Hence, to maintain and improve research excellence at the Faculty, it is critical to offer modern, optimally designed facilities for the conduct of such research. Continued delays in the acquisition of these will inevitably impact negatively on our performance in the future.

Finally, a renewed focus is required to increase access to, and dissemination of, research tools, data, and artifacts developed at the SJWRI for students and our professionals. We are now committed, with the support of the Division of Health Sciences, to exploring and engaging the use of new IT channels of communication and support, such as interactive web designs, material repositories, and open-source learning pools. These are exciting times for the SJWRI and the Faculty, and we look forward to working together with the broader University, as well as our allied professional bodies, to further dental research in New Zealand.

**Professor Jules Kieser**

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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's appointment advanced dentistry at many levels. He served as a spokesperson for dentistry at the World Health Organisation, led a campaign that overcame vociferous opposition to fluoridate water supplies in New Zealand cities, and succeeded after 10 years of struggle with reluctant university authorities (and even more reluctant government) to build the iconic glass curtain building that now houses the Faculty of Dentistry and bears his name. Under his leadership, the Faculty of Dentistry obtained the highest international standards by broadening its clinical and scientific base and reaching out to the dental profession and the community. Walsh edited the *New Zealand Dental Journal* for several years and had a reputation for being extremely scathing about dental practices that equipped too many New Zealand adults with "false teeth faces" in the mid-20th century. Walsh was a powerful advocate of research. Staff members in the Faculty of Dentistry were encouraged to undertake PhD study, and the School of Dentistry set out to 'grow' its own researchers by introducing the highly successful MDS graduate programme. This focus on research was achieved with the support of Walsh's ally, Sir Charles Hercus in the Medical School, himself also a dental graduate. In recent times, some fifty years after its initial introduction, the MDS degree was replaced by the Doctorate in Clinical Dentistry (DClinDent) featuring a considerably expanded research component, thus increasing 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 to improve and inform specialist dental practice through research would undoubtedly have been endorsed by Walsh.

Sir John Walsh's contribution to the development of the modern high-speed dental handpiece was one of his most significant but least well-known achievements. Electric drills introduced near the beginning of the First World War were inefficient and, by operating at only about 3000 rpm, caused considerable discomfort to patients. While testing the hearing of Australian airmen discharged from service at the end of World War II, Walsh not only identified frequencies that caused pain but also those that did not. This led to the hypothesis that the vibrational frequencies imparted by dental drills rotating at sufficiently high speeds would 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 available to Walsh, who then obtained the results that contributed to his DDSc from the University of Melbourne and to the issue of a New Zealand patent. Although the prototype overcame the pain problem and required minimal operator force to work efficiently, 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.

In 1952, Walsh's research on the air turbine handpiece ceased due to lack of funding. American and Swedish research had overcome the technical problems by about 1955 and, in 1957, the Borden Airotor was marketed by the Dentists' Supply Company. R.J. Nelson, who had produced a water- and powered cooled contra-angle handpiece, was then promoted (with the editorial

support of the Journal of one of his sponsors, the American Dental Association) as being solely responsible for the development of the high-speed drill. The precedence of Walsh's development of a high-speed air turbine handpiece that closely resembles the modern-day device can be gleaned from the pages of the *New Zealand Dental Journal* and a summary in the *British Dental Journal* (136, 469-472, 1974). The parallel drawn by Tom Brooking on the Walsh and Nelson contributions to dentistry with those of Richard Pearse and the Wright brothers to powered flight seems quite apt.

Walsh's attitude to research was very modern in its inclusiveness, while many of the barriers he faced in bringing its products into the clinic remain difficult to overcome. Walsh took a multidisciplinary approach to problems; he recruited the best people and obtained the best from them; he understood the risk inherent in cutting-edge research and didn't expect research or commercialization to be easy; and he came to understand that the perspectives of companies and politicians are often myopic. Not fazed by the disappointment of being unable to advance the high-speed handpiece further, Walsh worked hard to expand research activity within the Faculty of Dentistry by attracting research funding, establishing the Biochemical Research Unit within the Dental School in 1960, and supporting an electron microscopy suite, now reflected in the Otago Centre for Electron Microscopy. It is therefore fitting that the University of Otago acknowledged his contribution to research in dentistry by supporting the establishment of the Sir John Walsh Research Institute in the Faculty of Dentistry. The Institute's roles in research and communication with the profession and wider community seek to improve the oral health of New Zealanders, a modernisation of Walsh's aspiration of giving people 'teeth for life'.



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



# Research Highlights

## PUBLICATIONS

DEPARTMENT	CATEGORY	2011	2012
<b>Office of the Dean</b>			
	Journal - Research Article	6.04	4.97
	Journal - Research Other		1.2
	Journal - Professional & Other Non-Research Articles	1	
	Conference Contribution - Published proceedings: Full paper	0.25	
	Conference Contribution - Published proceedings: Abstract	9.38	10.89
	Conference Contribution - Poster Presentation (not in published proceedings)	0.92	
	Conference Contribution - Verbal presentation and other Conference outputs	4.29	2.17
<b>Office of the Dean (Dentistry)</b>		<b>21.88</b>	<b>19.23</b>
<b>Technical Services</b>			
	Journal - Research Article		0.83
<b>Technical Services</b>			<b>0.83</b>
<b>Oral Sciences</b>			
	Authored Book - Research		1
	Chapter in Book - Research	2.33	1
	Journal - Research Article	35.61	45.28
	Journal - Research Other	1.7	6.73
	Journal - Professional & Other Non-Research Articles		1.5
	Conference Contribution - Published proceedings: Full paper		4.5
	Conference Contribution - Published proceedings: Abstract	19.86	31.38
	Conference Contribution - Poster Presentation (not in published proceedings)	3.65	1.1
	Conference Contribution - Verbal presentation and other Conference outputs	7.52	2.52
	Intellectual Property	1	
	Commissioned Report for External Body	0.5	
	Other Research Output		1
	Awarded Doctoral Degree	1	
<b>Oral Sciences</b>		<b>73.17</b>	<b>96.01</b>
<b>Oral Diagnostic &amp; Surgical Sciences</b>			
	Journal - Research Article	14.97	7.77
	Journal - Research Other	0.83	1.33
	Conference Contribution - Published proceedings: Full paper		3.5
	Conference Contribution - Published proceedings: Abstract	6.72	8.87
	Conference Contribution - Poster Presentation (not in published proceedings)	0.57	0.18
	Conference Contribution - Verbal presentation and other Conference outputs	3.64	3.7
<b>Oral Diagnostic &amp; Surgical Sciences</b>		<b>26.73</b>	<b>25.35</b>
<b>Oral Rehabilitation</b>			
	Chapter in Book - Research	1	
	Journal - Research Article	22.43	33.84
	Journal - Research Other	1.67	5.53
	Journal - Professional & Other Non-Research Articles		0.5
	Conference Contribution - Published proceedings: Full paper		2
	Conference Contribution - Published proceedings: Abstract	10.04	11.16
	Conference Contribution - Poster Presentation (not in published proceedings)	6.03	0.18
	Conference Contribution - Verbal presentation and other Conference outputs	1.58	1.75
<b>Oral Rehabilitation</b>		<b>42.75</b>	<b>54.96</b>
<b>Total for Faculty of Dentistry/Sir John Walsh Research Institute</b>		<b>164.52</b>	<b>196.38</b>

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.

## RESEARCH FUNDING

Funder	AWARDED 2011		AWARDED 2012		COMBINED 2011-12	
	#	Value	#	Value	#	Value
Dentsply	1	\$3,133	2	\$2,250	3	\$5,383
Downie Stewart Fuller Scholarship	9	\$25,000	5	\$10,000	14	\$35,000
FORENZAO Charitable Trust	4	\$11,136			4	\$11,136
Health Research Council:						
- Programme*			1	\$1,020,000	1	\$1,020,000
- Feasibility Study	1	\$146,826			1	\$146,826
Lottery Health Research	1	\$13,467			1	\$13,467
Maurice & Phyllis Paykel Trust:						
- Project	1	\$10,000	1	\$8,000	2	\$18,000
- Travel	1	\$2,000	2	\$2,500	3	\$4,500
- Conference support			1	\$4,000	1	\$4,000
Ministry of Health:						
- Oral health self-care in adults			1	\$230,332	1	\$230,332
- CBG subcontract			1	\$43,478	1	\$43,478
NZ Dental Association:						
- Ministry of Health ORF	5	\$130,259	4	\$47,419	9	\$177,678
- NZDA Research Foundation	11	\$119,419	9	\$111,982	20	\$231,401
NZ Pharmacy ERF	1	\$12,250			1	\$12,250
OIL Proof of Concept	1	\$50,000			1	\$50,000
Otago Medical Research Foundation:						
- Jack Thomson Arthritis Fund			1	\$29,473	1	\$29,473
UMAT			1	\$65,121	1	\$65,121
UoO Centres			1	\$75,000	1	\$75,000
UoO Research Grants			5	\$138,679	5	\$138,679
Wishbone Trust			1	\$14,560	1	\$14,560
<b>TOTAL</b>	<b>36</b>	<b>\$523,490</b>	<b>36</b>	<b>\$1,802,794</b>	<b>72</b>	<b>\$2,326,284</b>

# - number of contracts awarded

\* SJWRI/Faculty of Dentistry component of Health Research Council Programme 'Oral health to age 38' led by Prof Richie Poulton, Dunedin Multidisciplinary Health & Development Study (awarded \$5.67M over five years in 2012.)

## NEWS AND EVENTS

### 2012 PERFORMANCE BASED RESEARCH FUND QUALITY EVALUATION

The SJWRI would like to thank all academic staff who contributed to the Faculty of Dentistry's success in the recent Performance Based Research Fund (PBRF) Quality Evaluation for 2012, which reveals the remarkable gains in research productivity achieved by our faculty and within the larger University sector since the PBRF exercise was last conducted in 2006.

The PBRF Quality Evaluation, carried out by the government under the auspices of the Tertiary Education Commission (TEC), examines the quality of research performance by all eligible academic and research staff in New Zealand Universities and other tertiary education organisations. The 2012 evaluation reveals that Otago has more than 700 individual staff graded as either 'A' or 'B' for the quality of their research. 'A' graded researchers are judged as possessing high international standing in their fields and 'B' as enjoying high national standing. Since the 2006 evaluation, Otago's number of 'A' staff has increased from 144 to 189, while numbers of 'B' staff have risen from 473 to 546. The University improved its score in all four Average Quality Score metrics used by TEC to evaluate quality of research personnel and outputs. Otago was ranked first among New Zealand universities in the measure of research quality weighted by its postgraduate roll, and second in the measure weighted by degree-level enrolments and higher. The University is also the only tertiary education organisation to be ranked in the top four in all four quality measures.

### SUBJECT AREA RESULTS

The Subject Area of Dentistry increased its Average Quality Score significantly since the previous assessment, largely due to the contribution of academic staff in our Faculty who make up the vast majority (over 97%) of Dentistry researchers in New Zealand. Dentistry was ranked 11th of all 42 subject areas assessed by TEC, and is one of only eight subject areas to have 20% or more of its researchers ranked 'A'. This underlines the unparalleled strength in Dentistry research within our Faculty.

### NOMINATED ACADEMIC UNIT RESULTS

The Faculty of Dentistry was ranked 21st of 48 Nominated Academic Units (i.e. departments, schools or other organisational groupings nominated by the host institution) at the University of Otago, with an AQS of 5.0, a marked increase on both the 2006 and 2003 assessments and above average for Otago NAUs. Of all NAUs in the Division of Health Sciences, the Faculty is ranked fourth (behind only University of Otago Christchurch, the National School of Pharmacy and the Department of Biochemistry) and is one of only three units in the Division to have increased its number of both 'A' and 'B' ranked researchers since the previous audit; in terms of full-time-equivalent staff members, the Faculty scored 8.02 'A's, 14.69 'B's and 18.53 'C's.



## SJWRI RESEARCH CENTRE RECOGNISED

Following a rigorous application process, The Sir John Walsh Research Institute became one of 14 groups to be formally designated as a 'University of Otago Research Centre' for at least the next five years, beginning November 2012.

Deputy Vice-Chancellor (Research & Enterprise) Professor Richard Blaikie said, "Each of these centres bring together many of our finest researchers in collaborative, multidisciplinary research platforms or programmes pushing the frontiers of knowledge in their areas."

A demonstrated commitment to reach out and engage with relevant sectors of the community, business and government was among the selection criteria for the centres.

"At Otago, we believe that it is important that our research activities can be translated into real-world benefits wherever practicable. This goal is much more likely to be achieved if researchers forge close links with the end users of the research and other interested external parties," he says.

The research the centres are undertaking covers a broad spectrum. It ranges from pursuing advances in atomic and optical physics that will underpin new technologies, through to exploring the development of colonial culture and how it has shaped New Zealand society. Two centres are conducting large programmes looking at key aspects of how New Zealand can become more sustainable, while others have a strong focus on helping to bridge gaps between science and society. A number of centres, including ourselves, are involved in world-leading health-related research, with the goal of ensuring findings can be translated into improved treatment of diseases and disorders. Areas of focus include brain health; cancer; cardiovascular disease; diabetes and obesity; lifecourse studies; infectious diseases; neuroendocrinology; and oral health.

The University of Otago is committing more than \$2.5M over the next five years to support the internationally outstanding work of its leading research centres. The funding from the University's Research Committee will supplement other grants and contributions from academic divisions over this period to support their world-class research activities.

## SIR JOHN WALSH RESEARCH INSTITUTE RESEARCH DAYS

### Research Day 2011



On Thursday 11 August 2011, the Sir John Walsh Research Institute held its fifth annual research day. Students, practitioners, and academics from around the world joined us for a day that celebrated the research accomplishments of the staff, students and friends of the Sir John Walsh Research Institute.

Keynote speeches were offered by:

Professor Dianne Rekow (NYU Senior Vice Provost for Science and Technology) – 'What compromises performance of all-ceramic crowns?'

Professor Van Thompson (Professor and Chair, NYU Department of Biomaterials and Biomimetics) – 'PEARL Practice Based Research Network Results: posterior composite restoration and dentin caries activity, noncarious cervical lesion treatment and endodontic treatment patient centered outcomes'

Professor Shinya Murakami (Professor and Chairman, Osaka University Department of Periodontology) – 'FGF-2 stimulates periodontal regeneration'

The Student Guest Speaker was our own Student Guest Speaker Grace Lee, winner of the 2011 Hatton Prize (Junior Category) from the International Association for Dental Research (see separate article). Grace's presentation was titled 'Inhibiting drug efflux pumps relevant to fungal infections and cancer: developing fluorescence assays of efflux'.



The award for best student speaker was won by Guy Farland, whose paper 'Under Pressure: Are We All The Same?' examined the pressures involved in swallowing for the first time. The international panel of judges praised Guy's work for 'pushing back the boundaries of science' and applauded its originality.

### Research Day 2012

The 2012 edition of the annual SJWRI Research Day was held on Thursday 2 August in the Hutton Theatre, at the Otago Museum. Keynote addresses were delivered by:

Professor Deborah Greenspan (Professor of Oral Medicine, Leland A. and Gladys K. Barber Distinguished Professor in Dentistry and Chair, Department of Orofacial Sciences, School of Dentistry, University of California, San Francisco) – 'HIV/AIDS At Thirty Years'.

Professor John Greenspan (Associate Dean for Global Oral Health in the School of Dentistry at University of California, San Francisco) – 'Partnering for Global Oral Health'.

Steve Ting, Teaching Fellow, Centre for Science Communication, University of Otago – 'Science and Storytelling: How I gave up on tape measures and picked up a camera.'

The award for best student speaker was won by Sobia Zafar. Sobia's presentation, 'Effects of biphosponate on angiogenic gene expression in human gingival fibroblasts' highly impressed the national and international judges.

The Sir John Walsh Research Institute Research Days 2011 and 2012 were made possible by the generous support of 3M ESPE.

**3M** ESPE



Professor Deborah Greenspan



Professor John Greenspan

## INAUGURAL NEW ZEALAND FORENSIC BIOMECHANICS SYMPOSIUM

Environmental Science and Research (ESR) and the Sir John Walsh Research Institute were proud hosts of the inaugural New Zealand Forensic Biomechanics Symposium held on Tuesday, 15 February 2011.

The symposium provided a welcome opportunity for members of the forensic biomechanics community to present their current research and plan for possible future collaborations. Guest speaker Dr David Baldwin, Director of the Midwest Forensic Resource Centre, Ames Laboratory, Iowa, opened the day's proceedings with a keynote presentation on the forensic scene in the United States.

In addition to being a valuable benchmarking exercise, the symposium provided an opportunity for forensic biomechanics students to present their results to an international forum.

Following the success of the inaugural event, highly successful SJWRI-ESR Forensic Biology Symposiums were subsequently held in 2012 and 2013.



## 2011 SIR JOHN WALSH RESEARCH INSTITUTE AWARDS

The Sir John Walsh Research Institute Awards celebrate high quality research achievements and support within the Institute and the Faculty of Dentistry.

### Postgraduate Publication Award: Mo'men Atieh (Biomechanics and Oral Implantology)

This award is for the best paper published or accepted for publication between 1 January 2010 and 31 December 2010 by a masters or doctoral student. Its purpose is to encourage young researchers completing their masters or doctorate to publish an article in a professional refereed journal that will enhance their research portfolios. The winner receives \$500.

### Sir John Walsh Research Publication Award: Neil Waddell (Biomechanics and Oral Implantology)

This award is to recognise excellence in research by acknowledging the research calibre and effort required to produce a paper for the highest ranking journals of science or dentistry. The publication must have been accepted between 1 January and 31 December 2010. The winner receives \$1,000.

### Research Support Award: Liz Girvan (Otago Centre for Electron Microscopy)

This award is to recognise the excellent support provided by general staff to research groups, units and/or departments within the Faculty of Dentistry. The winner receives \$2,000 towards attendance at a conference.



Liz Girvan with Andrew Tawse Smith of the SJWRI in the scanning electron microscopy suite of the OCEM, Department of Anatomy.

### Basic Research Award: Dr Nicholas Heng (Molecular Microbiology)

The Sir John Walsh Research Institute, on behalf of the Faculty of Dentistry, wishes to acknowledge and promote basic research by a member of staff or postgraduate student in the Faculty of Dentistry. This award is to support a research development initiative that could make a contribution to the strategic direction of research within the Institute. The winner receives \$5,000 towards their continuing research.

### Clinical Research Award: Associate Professor Warwick Duncan (Biomechanics and Oral Implantology)

The Sir John Walsh Research Institute, on behalf of the Faculty of Dentistry, wishes to acknowledge and promote clinical research by a member of staff or postgraduate student in the Faculty of Dentistry. This award is to support a research development initiative that could make a contribution to the strategic direction of research within the Institute. The winner receives \$5,000 towards their continuing research.

### Sir John Walsh Research Award: Professor Richard Cannon (Molecular Microbiology)

The Sir John Walsh Research Institute, on behalf of the Faculty of Dentistry, wishes to acknowledge excellence in research over an extended period of time (more than 10 years) by a member of staff of the Faculty of Dentistry. The winner receives \$3,000 towards professional development.

#### ABOUT THE SIR JOHN WALSH RESEARCH AWARD WINNER

Professor Richard Cannon's research into the microorganisms that cause oral disease began more than twenty-five years ago, and has moved in some very surprising directions. What began as an exploration of the ways in which microorganisms adhere to saliva-coated surfaces in the mouth, leading to oral thrush and other, potentially more serious problems, has resulted in a groundbreaking technology platform that has wider implications for AIDS patients, cancer research, and veterinary medicine.

Professor Cannon, along with students and colleagues at the Faculty of Dentistry's Sir John Walsh Research Institute, has spent the last decade developing a novel way of introducing proteins from the pathogen *Candida albicans*, responsible for making the fungus resistant to antifungal agents, into common baker's yeast (*Saccharomyces cerevisiae*). This enables partners at research institutions around the globe to bombard the yeast cells with literally hundreds of thousands of compounds in a matter of days. This high-throughput screening (HTS) approach enables researchers to identify compounds with the potential to inhibit the resistance of *C. albicans* to antifungal drugs. The HTS has already identified hundreds of compounds with potential applications for patients who have received organ transplants or are suffering from AIDS, leaving them vulnerable to systemic fungal infections.

Professor Cannon and his team are currently conducting research to identify the most effective of the compounds they have discovered to date, while simultaneously looking at ways to adapt their technology to other fields of research. One avenue for further exploration is to apply the HTS methodology to tumours that have shown resistance to chemotherapy, looking for new drugs that can defeat these resistant forms of cancer. Another is in the agricultural industry, where resistance to the drenches used to treat sheep and cattle with intestinal worms is a multi-million dollar problem. His team is investigating whether their HTS platform can be used to discover drugs that will restore the potency of existing and well-trusted drenches for which resistance has developed.

Professor Cannon's work has been, and continues to be, a credit to the Sir John Walsh Research Institute, and we congratulate him on this award, which recognises his distinguished research contribution to both dentistry and the wider field of medicine.



## CLEANING UP DENTAL DISPARITIES

University of Otago researchers seeking to develop ways to reduce chronic dental disease among Māori children will be doing so as part of an international initiative.

The project is a partnership between Māori, Indigenous Australians and First Nations Canada, under the umbrella of the International Collaborative Indigenous Health Research Partnership. The Health Research Council (HRC) is putting more than \$2.3 million in funding into the New Zealand part of the project.

Professor John Broughton, who is director of the University-based Ngāi Tahu Māori Health Research Unit, is lead investigator for the New Zealand research and is working closely with Professor Murray Thomson and Kate Morgaine in the Faculty of Dentistry. All three are affiliated with the SJWRI's Dental Epidemiology and Public Health research programme.

"Oral health disparities between indigenous populations and the rest of the population are a global thing," says Professor Broughton. "The cause is multifactorial. Diet, oral health behaviours, fluoridation, social determinants of health – those sorts of things."

Early childhood caries can become the focus of disease, pain and discomfort in the body, he says. "It can compromise their eating, their diet, and their behaviour. It can impact upon the quality of their life and impact on other members of the family."

The New Zealand research is being conducted in partnership with Tainui through their health provider, Raukura Hauora O Tainui, and the Waikato Tainui College for Research and Development, established by the late Sir Robert Mahuta.

"They are leading the project on the ground so it is all being done within their tribal area. They have the clinical facilities, while the college has the strong research kaupapa."

Professor Broughton points to some startling statistics when putting the case for such research in New Zealand. For example, Waikato District Health Board data on preventable hospital admissions for 2007 indicate that 12.8 per cent of admissions involving children aged up to four years were for dental reasons, making it the second highest cause. In the next age group (five–14 years) the figure for admissions due to dental problems jumped to 30.8 per cent, making it the highest cause in that age group.

The project is looking at New Zealand Māori mothers and their babies, and to safeguard the oral health of the mothers as well as that of the children.

"The thing about it is that all dental disease is preventable. And if you have a parent with poor oral health, and if you have a parent who has a high caries rate and a virulent strain of bacteria in their mouths they can infect their babies – just by kissing them."

By restoring and maintaining the oral health of the parents, and then other interventions along the way, it is hoped the babies can grow up without any oral pathology.

The researchers are currently recruiting 200 pregnant mothers for the five-year study who will be split into two randomised groups – an intervention group and a delayed intervention group so that all participants get the benefits of the interventions.

The intervention has two components: dental treatments for mothers and motivational interventions.

"It is called motivational and participatory guidance. It's not telling the participants what they should and shouldn't do; it's leading them into the position where they make those decisions themselves," says Professor Broughton.

"This is a good example of whānau ora. It's not just focused on the individual; it's focused on the family and the environment as well."

Reprinted with permission from *He Kitenga Māori*, University of Otago 2011



## FILLING FIX WINS PAIR PROOF OF CONCEPT GRANT

Development of silver nanoparticle-based materials for treating dental caries won Dentistry Senior Lecturer Dr Don Schwass and Chemistry Lecturer Dr Carla Meledandri the 2011 Otago Innovation Proof of Concept Grant worth \$50,000.

Drs Schwass and Meledandri are together researching the application of silver-nanoparticles as a way to deliver and maintain antibacterial effects deep within the tooth. Their aim is to create a product that eliminates bacteria and prevents its recurrence under and around fillings. The Proof of Concept Grant will help fund their efforts to prove that these ultra-small nanoparticles are effective on teeth, as well as to conduct toxicity studies and then take the work to a stage that will interest dental materials manufacturers.

The project began with Dr Schwass's interest in new strategies for prevention of dental caries (tooth decay).

Dr Schwass felt the chemical compound silver diamine fluoride showed real promise, but when applied on teeth it leaves an unappealing black silver fluoride deposit on the cavity surface of carious lesions. A chance encounter at a speed-collaboration exercise for Otago academic researchers linked him with Dr Meledandri, who is interested in nanoparticles. In partnership, the pair have developed suspensions of silver nanoparticle-based materials which testing showed to have tremendously potent antibacterial qualities at very low concentrations. At these concentrations, the nanoparticle suspensions appear pale yellow in colour, or more often, completely colourless, solving the aesthetics problem.

In January 2013, with support from Otago Innovation Ltd, a provisional patent application was filed pertaining to the assembly of micelle aggregates of surfactant micelles and silver nanoparticles, and their use as an antibacterial agent. A suitable commercial partner is currently being sought to further develop this novel treatment into a marketable dental product.



## PHD CANDIDATE GEMMA DICKSON RECOGNISED FOR PRESENTING THESIS OF EXCEPTIONAL QUALITY

SJWRI Forensic Biology PhD candidate Gemma Dickson was recognised in December 2012 by the University as having presented a thesis of exceptional quality. Gemma's thesis 'Microbial marine decomposition of human and animal remains', supervised by Associate Professor Russell Poulter of the Department of Biochemistry and Professor Jules Kieser of the SJWRI, was submitted in 2012. A thesis is of exceptional quality when all three examiners of a candidate's thesis agree that the thesis is among the top 10% of theses examined, and is of an exceptional standard in the areas of research content, originality, quality of expression and accuracy of presentation.

Gemma's PhD research investigated the involvement of marine bacteria in decomposition of human and animal remains in coastal marine environments. Surrounded by coastline, New Zealand sees an unusually high number of accidental and suspicious deaths occurring at or around the sea. Established methods that determine time of death for corpses on land, such as levels of decomposition or infestation by insects, aren't useful or informative for submerged bodies. Human remains in seawater are subject to a large number of decompositional factors, dependent upon the remains themselves and the specific marine environment. "Unless a body is witnessed entering the water, there is no reliable method for determining

the length of time that a body has been submerged," says Gemma, quoted in leading popular science magazine *New Scientist* in 2010. Marine bacteria appear to play an integral role in marine decomposition, though this process is poorly understood.

Gemma's research investigated whether the types of marine bacteria colonizing a body changes as it decomposes, serve as a postmortem 'clock', enabling determination of the length of time a body has been submerged in the sea, a critical factor that must be determined in any death investigation. Adult pigs' heads, used as an analogue for human cadavers, were submerged in Otago Harbour for up to three weeks, or until they were reduced to a bare skull, while sampling the bacteria on their decomposing skin was carried out every two to four days. To determine the effect of water temperature on bacterial colonisation, heads were submerged in autumn, early winter and late winter. Gemma found that stages of decomposition had different bacterial signatures. For example, for the heads submerged in winter, *Psychromonas* bacteria colonised during the first stages of decomposition, while specific *Bacteroidales* genera only colonised after 10 days of submersion. From this, a characteristic profile of bacterial genera could be established to infer time of entry into the water. Gemma's findings were published in leading forensics journal *Forensic Science International*, as well as being reported in national and international media.



## POLICE COMMISSIONER AWARDS DARNELL KENNEDY

SJWRI PhD candidate Darnell Kennedy was honoured for an article which appeared in the *Australian Police Journal* in October 2012. The article "Forensic Dentistry and Microbial Analysis of Bite Marks" was published in March last year, winning Darnell first place in the education sector of the journal's awards.

In recognition of her achievement, Darnell was presented with a plaque and cheque by New Zealand Police Commissioner Peter Marshall at the Dunedin Central Police Station. "I thank you for what you have done, what you are doing now, and no doubt what you will go on to do," he told Darnell during the presentation.

Darnell says she has had a lifelong interest in law enforcement and developed a love for science-based research in early high school.

"I therefore consider myself extremely fortunate to be given the opportunity to perform research that encompasses both. But even more fortunate is the fact that I am under the guidance of three very supportive and nurturing supervisors, Professor Jules Kieser, Dr Geoffrey Tompkins and Dr Jo-Ann Stanton, to whom I credit much of my growth as a budding researcher."

Darnell commenced her PhD studies in 2009, looking at whether streptococcal DNA from a bite mark can be matched to DNA obtained from the teeth of the biter. Bite marks predominate in some of the most serious crimes, the most common of which are sexually motivated attacks and child abuse. Current conventional methods of analysing bite marks involve an element of subjectivity. The most objective mode of analysis involves the recovery of the biter's DNA from a bite mark. However, this is not often successful because enzymes in saliva degrade DNA. Oral streptococci are predominant colonisers of the tooth surface and are subsequently deposited in a bite mark. Past research suggests that individuals harbour their own unique collection of streptococci. Darnell's research was aimed at investigating whether streptococcal DNA from a bite mark can be matched to that obtained from the teeth of the biter, utilising a high-throughput DNA sequencing approach (the Roche 454 Genome Sequencer FLX instrument) to provide the DNA sequence data in which to make the comparisons. Darnell completed her thesis in late 2012. She donated the money she was awarded (\$500AU) to the New Zealand Forensic Science Society.



## DENTAL STUDENT WINS TOP RESEARCH PRIZE AT INTERNATIONAL CONFERENCE

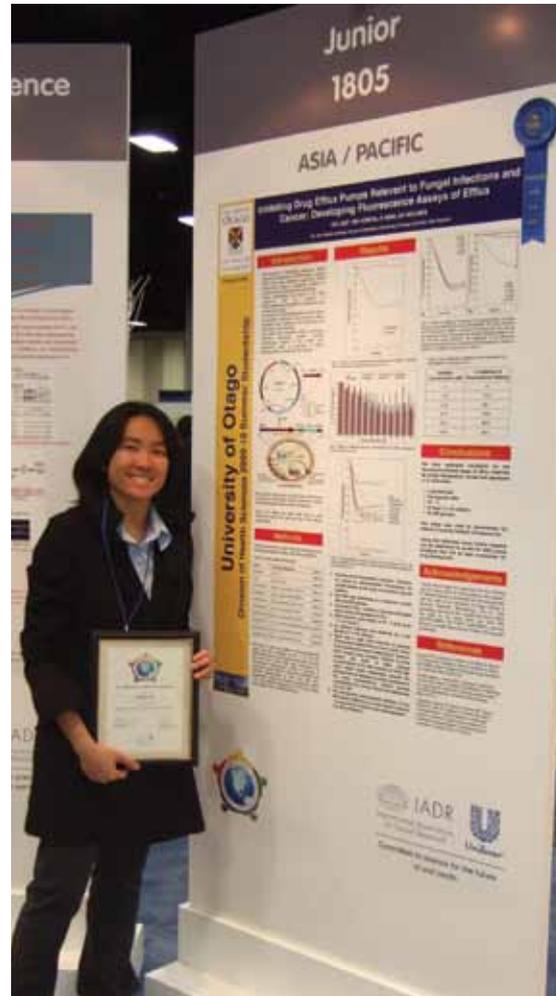
Fifth year dental student Grace Lee won first prize in the Hatton Competition (Junior Category) at the 89th General Session of the International Association for Dental Research (IADR) in San Diego, USA, March 2011.

Grace undertook a research project to investigate how drugs are pumped out of drug-resistant fungal cells. She developed a way of measuring pump function and used this to identify a pump inhibitor that could overcome fungal drug resistance.

Her research was selected by the New Zealand branch of the IADR to compete in the Australasian IADR poster competition in Kiama, Australia, in late 2010. She won that competition and received a travel grant from Unilever to enable her to compete in the Hatton Competition in San Diego. There she was up against the top dental students selected from North America, Latin America, Europe, Asia, Africa and the Middle East.

Her research was supported by a University of Otago Division of Health Sciences Summer Studentship, and funding from the NIH, USA, and the Foundation for Research Science and Technology. This marked the second time in four years that the Hatton competition has been won by a student from the Sir John Walsh Research Institute. Both Grace and the previous winner, Shilpa Raju, were supervised by Dr Ann Holmes within the Molecular Microbiology research programme.

Grace was awarded a plaque and a prize of US\$1,600.



## OTAGO STUDENT RECOGNISED AT IADR ANZ CONFERENCE

In September 2011 Inah Kim, a fifth year dental student, came runner up in the Colgate competition (Junior Category) at the Australia and New Zealand meeting of the International Association for Dental Research (IADR) in Melbourne, Australia.

Inah carried out a research project to describe three-dimensional mandibular growth using cone-beam computed tomography (CBCT). She developed an animal model system to superimpose 3D data sets and an initial 3D analysis of mandibular growth in a rabbit model. Her research was selected by the New Zealand branch of the IADR to compete in the Australasian IADR poster competition. She has been awarded a travel grant from Colgate to present her research in the 90th general session to be held in Rio de Janeiro, Brazil in June 2012. Here she will present her study amongst top dental students selected from North America, Latin America, Europe, Asia, Africa and the Middle East.

Her research was supported by a University of Otago Division of Health Sciences Summer Studentship, and funding from Education and Research Development Group (ERDG), from the New Zealand Association of Orthodontists (NZAO).



(Left to right) Professor Mauro Farella, Inah Kim, and Associate Professor Warwick Duncan.

## IADR POSTER COMPETITION WINNERS 2011

The winners of the New Zealand section IADR student poster competition were announced at a small ceremony held on Thursday 19 May 2011. The judges noted that the standard this year was particularly high and, accordingly, four prizes were awarded. The winners are as follows:

### Colgate prizes

The winners received \$2,000 from Colgate New Zealand to assist the students to represent the New Zealand section at the IADR Australian/New Zealand Division meeting to be held in Melbourne in September 2011.

Miss Inah Kim

*Three dimensional evaluation of mandibular growth in rabbits*

Supervisors: Dr W Duncan and Professor M Farella

Miss Huong Ho

*Prenatal alcohol exposure's effects on the morphology and mineralization of mice's first molars*

Supervisors: Dr R Napper, Professor J Kieser

### IADR ANZ Division Travel Awards

The winners received \$700 towards registration and accommodation, plus return economy airfares, to present their work at the IADR Australian/New Zealand Division meeting in Melbourne.

Miss Doreen Ng

*Neck and shoulder muscle activity during dentistry-related postural tasks*

Supervisors: Dr C McNee, Professor J Kieser, Professor M Farella

Miss Debra Li

*Negative pressure, cavitation effect and swallowing*

Supervisors: Professor J Kieser, Professor M Swain, Dr Chris Bolter



(From left to right) Inah Kim, Associate Professor Nick Chandler, and Huong Ho.

## IADR POSTER COMPETITION WINNERS 2012

The following students won grants to support their attendance and compete at the IADR ANZ Division's 52nd Annual Conference, held in Denarau, Fiji, in September 2012.

### IADR NZ Section Colgate Poster Competition

Postgraduate – Mr Ben Seo, Endoplasmic reticulum stress and Russell bodies in periodontal inflammation

Undergraduate – Miss Ceridwen Benn, Identifying individual possums using their oral bacteria.

### IADR ANZ Division Travel Grant

Miss Fiona Firth, Regulation of immune cells in lichen planus.

## OTHER STUDENT AWARDS AND HIGHLIGHTS

### Hannah Jack

was awarded an Advance Ashburton Community Foundation Special Award in March 2011. At the time of the award Hannah was a second year Doctorate of Clinical Dentistry student, specializing in Orthodontics.

Advance Ashburton Community

Foundation is a charitable trust which aims to improve health and education in the Ashburton region, as well as support the arts, sports and cultural groups, and a number of other charitable causes. The scholarship was awarded to Hannah as she grew up in the Ashburton area, and is currently undertaking post-graduate study in the Health Sciences area. The scholarship will be put towards orthodontic instruments and textbooks required for her course. Hannah undertook a research project as part of her doctorate investigating the role of lip pressures in orthodontic relapse of the lower anterior teeth.

Following completion of her DClintDent in 2012, Hannah was awarded the John McDonald medal for having the highest overseas mark in the Membership in Orthodontics (MOrth) examination in 2012. This examination is run by the Dental Council of the Royal College of Surgeons of Edinburgh, with those passing the exam being granted acceptance to the College. There are





a number of sittings of these exams, one in Edinburgh, Adelaide (which Hannah sat), Hong Kong, Dubai and Cairo, and Hanna scored the best mark from these overseas exams. As part of the assessment procedure Hannah was expected to submit some of her own orthodontic cases as well as being examined on other orthodontic topics.

**Stephanie Ting**, a Bachelor of Dental Technology with Honours student, was awarded an Electron Microscopy Student Research Award in June 2011. Two representatives of the OCEM User Group and two representatives of the OCEM Management Committee met to judge the 2011 EM Student Awards. Nine applications were received by the selection panel, and owing to the high standard of applications, two awards were allocated. Stephanie's project is entitled "The influence of a metal conditioner on the bond strength and residual stress of a porcelain-fused-to-metal system". The Award provides Stephanie with up to 15 hours electron microscope usage.

**Daniel Sundaresan**, a final year BDS student, won first place in the Otago Medical School Research Society (OMSRS) student speaker awards held on May 9 2012. Daniel carried out his research on a Summer Scholarship and was supervised by Nick Heng, Mary Cullinan and Bernadette Drummond.

Also in May 2012, **Dr Michael Tholey**, our first PhD student in Dental Technology visited the Faculty as part of the cooperation Vita Zahnfabrik has with the members of the Biomaterials discipline as headed by Professor Michael Swain. Dr Michael Tholey is employed in the Research and Development department of leading dental technology firm Vita Zahnfabrik, Germany.

**Sajal Shah**, a forensic biology Masters student in Forensic biology supervised by Prof Jules Kieser in the SJWRI, was awarded the AFTE Prize in July 2012. The Association of Firearm and Tool Mark Examiners (AFTE) is an international organisation who support forensic science students by awarding US\$2000 annually. Sajal Shah was chosen based on her academic transcript, reasons for pursuing a career in forensic science, contributions made to the field of forensic science and finally, recommendations by academic advisors and employers.

Following her award as best student speaker at SJWRI Research Day 2012 (see separate story), Oral Molecular and Immunopathology PhD student Sobia Zafar won the Colgate Senior Category Runner Up Award for her poster presentation at the 52nd Annual Meeting of the IADR Australia & New Zealand Division, which was held in Denarau, Fiji in September 2012.

# Research Programme Profiles

## BIOMECHANICS AND ORAL IMPLANTOLOGY

Programme Directors: Professor Michael Swain and Professor Jules Kieser

Clinical dentistry combines rules on evaluating and choosing different technologies, knowledge about oral function, materials and designs, together with experience of what works and what does not. However success depends greatly upon an understanding of the scientific basis of the constituent parts of the system.

Practical biomechanical innovation is how we describe our approach to research. The term biomechanics, much like similar hybrid terms such as bioarchaeology or biophysics, covers an area of knowledge that involves the application of a specific discipline to an aspect of biology. Craniofacial biomechanics is focused on the application of engineering principles to dentofacial structures and tissues. Our research programme strives to develop solutions that have real benefits for both the public and the profession of dentistry in New Zealand and around the world. The area of biomechanical research has established a reputation for investigations in basic as well as clinical fields, ranging from novel implant systems to forensic science.

Members of our research team focus on a number of related areas of expertise to undertake relevant research and build strategic partnerships, as well as educating both under- and post-graduates who are ready to enter their chosen profession. Collaborations both within and outside of New Zealand bring together researchers from universities, government laboratories and industry to achieve real outcomes of national economic and social significance. The major themes of research within our programme include dental biomaterials, natural soft and hard tissues, bioforensics and implantology.

Research excellence increasingly relies on partnerships both with industry and funding organizations. Although the SJWRI has an excellent track record in this regard, there are several exciting new opportunities for partnerships that need to be developed in the coming years to help advance research excellence in the field of Oral Implantology and Biomaterials. In this regard, our researchers have focused on:

- Developing international partnerships for defined areas of enquiry
- Creation of new partnerships for research across the university
- Facilitation the commercialization of our ideas
- The development of partnerships with other New Zealand institutions necessary to make our research successful

- Expanding research capacity by acquisition of the latest instrumentation needed for such research.

Excitingly, there is no end in sight to the ongoing technological revolution. Our researchers are actively engaged in developing new materials and processes for sustainable restoration of teeth and the jaws that house them. We are trying to establish new paradigms in implantology, orthodontics, forensics and restorative materials, and in so doing, accepting the dual challenges of an ageing population as well as a younger population with a massive dental decay rate. Nanoscience and microscience are redefining possibilities of examination and analysis of natural and synthetic materials. Our group is exploring fundamental properties of teeth and materials through advances in sensors, imaging and myriad other technologies.

Intellectual property, including the negotiations over who gets to reap the financial and other benefits from it, remains central to our thinking. Our conceptions of new and emerging technologies and the roles they play in the development of our profession are the exciting drivers of much of our research.

### KEY PERSONNEL

Professor Mike Swain  
 Professor Jules Kieser  
 A/Prof Warwick Duncan  
 Professor Mauro Farella  
 Dr Neil Waddell  
 Associate Professor Bernadette Drummond  
 Dr Vincent Bennani  
 Dr Lihong He (deceased)  
 Ludwig Jansen van Vuuren  
 Dr Li Mei

### PhD students:

Momen Atieh	Andrea Coldea
Therese De Castro	Gemma Dickson
Rami Farah	Amanda George
Felicity Gilbert (Australian National University)	Sara Hanning
David Kieser	Erin Hutchinson (University of the Witwatersrand, South Africa)
Kai Chun Li	Anne-Christine Lindstrom
Carolina Loch Santos da Silva	Sunyoung Ma
'Reham Osman	Andrew Quick
Donald Schwass	Ajay Sharma
Allauddin (Dini) Siddiqi	Michael Tholey
Neil Waddell	Darnell Kennedy
Andrew Tawse-Smith	Yikun Wang
Diogo Zaniccotti	

## STUDENTS/COLLABORATIONS

Prof Jules Kieser and others in this group has been collaborating with a number of researchers, including:

Prof Ewan Fordyce of the Department of Geology co-supervised **Ms Carolina Loch Santos Da Silva** (pictured) who as completed a PhD thesis on the dentition of modern and fossil Cetacea (dolphins). This research has resulted in the publication of three articles in top end journals in the field.



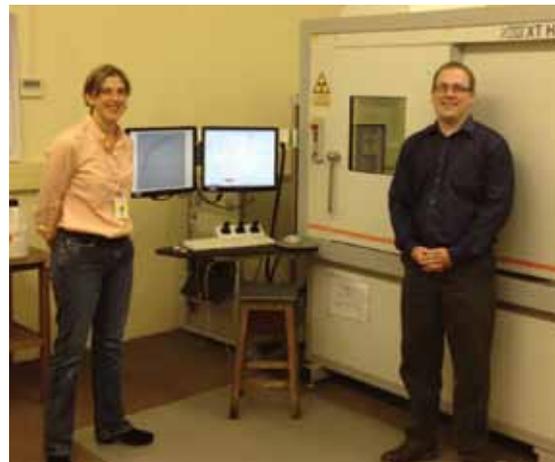
Prof Jean-Claude Theis of the Department of Orthopaedic Surgery, Dunedin School of Medicine, co-supervised **David Kieser's** PhD which focused on high velocity orthopaedic trauma. This research has already resulted in 5 publications and the award of the Dunedin School of Medicine Best PhD of 2013.



A/Prof Natalie Medicott of the School of Pharmacy co-supervised the PhD of **Sara Hanning** (pictured) who has focused her research on the development of an artificial saliva. The clinical application of this product to patients with severe xerostomia is currently being investigated in collaboration with Dr MaggieLee Huckabee of the Van DerVeer Institute, University of Canterbury, who is co-supervising Olivia Apperley's DCLinDent research.



Prof Beverley Kramer of the University of the Witwatersrand, Johannesburg, is co-supervising the PhD thesis of **Erin Hutchinson**, who is looking at the prenatal and early postnatal development of the human mandible. This research is being conducted using material from the RA Dart Collection and the advanced imaging facilities of the South African Nuclear Energy Corporation in Pelindaba. Erin is pictured with technician Kobus Hoffman at the micro-CT facility of the SANEC.



A/Prof Keith Probert, Marine Sciences and A/Prof Russell Poulter, Biochemistry co-supervised the PhD of **Gemma Dickson**, who studied the microbiology of marine decomposition. Not only was Gemma awarded a Tertiary Education Commission Top Achiever Award, but her thesis was selected by the University as being of 'exceptional quality', being in the top 10% of all doctoral theses submitted in 2012 (see separate article).



A/Prof Martyn Nash and the late Prof Andrew Pullan of the Department of Engineering Sciences, Auckland University together with Prof Oliver Rohrle of the Biomechanics and Mechanobiology Research Group at the University of Stuttgart, Germany, were involved in co-supervising **Yikun Wang's** PhD which centered on the biomechanical modeling of the human tongue during function. Yikun is pictured as a guinea-pig in his own research on tongue function, assisted by Nitin Raniga.



## CURRENT RESEARCH

Our research is aimed at defining and understanding the oral design environment. It examines the entire system, from basic structures such as enamel and bone to the fabrication of various materials and appliances used in clinical dentistry, including:

- The structure and material properties of oral tissues and their responses to biological forces;
- Failure mechanisms of implant supported prostheses;
- Adhesion and design features of modern dental restorations;
- The structure of dentine and enamel in reptiles and dolphins;
- Enamel hypoplasia;
- Tongue pressure dynamics in the mouth;
- Artificial saliva; and
- Sharp and blunt force injuries to craniofacial structures.

## RESEARCH ACTIVITIES

### Activity 1. Dental Materials

*Description:* Evaluating specific issues associated with the range of dental materials from composite resin systems to advanced ceramics.

*Aim:* Provide basic information about these materials that enables a better basis for understanding their usage in clinical settings.

*Source(s) of funding:* New Zealand Dental Association Research Foundation and the Fuller Scholarship for Dentistry.

### Activity 2. 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 traumatic events.

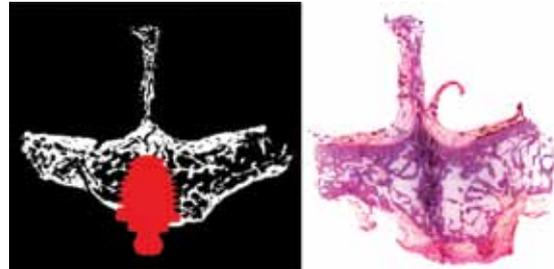
*Sources of funding:* New Zealand Dental Association Research Foundation, United States Department of Justice, ESR Capability Development Fund.

### Activity 3. Implantology and associated superstructures

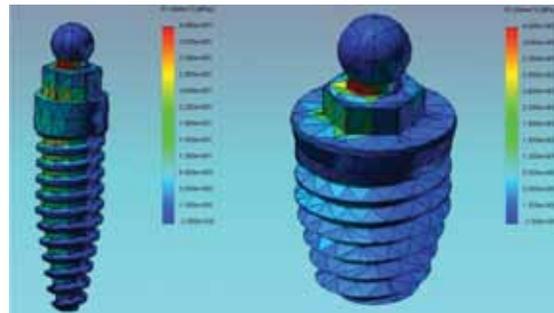
*Description:* Our research teams have expertise with respect to conducting clinical (human) and preclinical (animal) trials and laboratory-based research relating to oral implants. Currently, funded research is being conducted into different oral implant systems, materials, surfaces, superstructures, and surgical and restorative protocols, as well as supporting biological and regenerative products. Graduate student research during 2010-2011 included immediate placement and/or loading of single implants and implant-supported over-dentures, fit of zirconia prostheses, implant analysis using micro-CT, and analysis of different implant systems and bone placement grafts in sheep femur and maxillary sinus models.

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

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



Micro-computerised tomographic image of human palate with superimposed silhouette of palatal implant (left) and histological images from the same site (right). Allauddin Siddiqi, PhD candidate.



First principal stresses in implants under oblique load on most distal implant on loaded side and on mid-palatal implant. Reham Osman, PhD candidate.

## KEY PROJECTS AND FUNDING SUCCESSES

### 2012

*New Zealand Lottery Grants Board* Wireless monitoring of oral pH and bruxism. (Mauro Farella, Jules Kieser and Michael Paulin, Physics). \$49 500 (awarded 2013)

*University of Otago Research Grant.* Rush of blood to the head: Psychological factors in the analysis of bloodstain evidence (Jules Kieser with Rachel Zajac, Psychology and Michael Taylor, ESR) \$21,000.

*University of Otago Research Grant.* Merging anatomical and fluorescence molecular imaging to investigate craniofacial growth (Jules Kieser, Mauro Farella and Warwick Duncan) \$35,000.

*University of Otago Research Grant.* Periosteum under stress: The effects of denture-induced gingival pressure on bone resorption (Jules Kieser, Sunyoung Ma, Warwick Duncan and Michael Swain) \$ 32,768.

*New Zealand Dental Research Foundation.* The effect of seawater degradation on DNA from teeth (Sarah Drake, Jules Kieser, Warwick Duncan and Alison Rich) \$15,000.

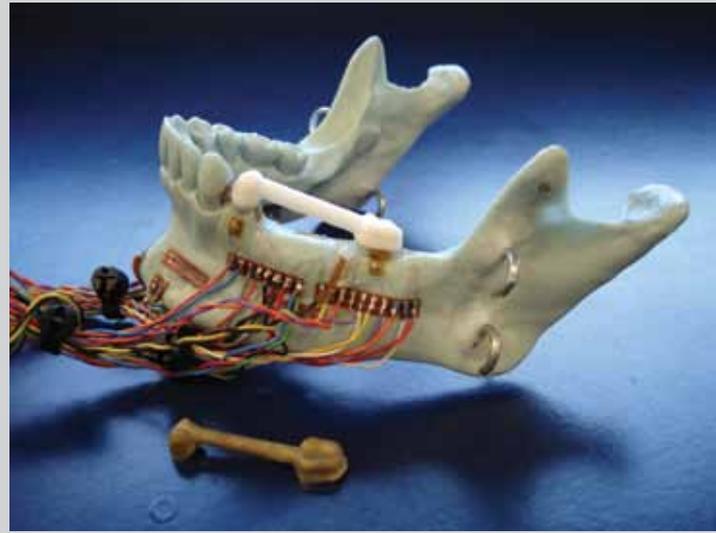
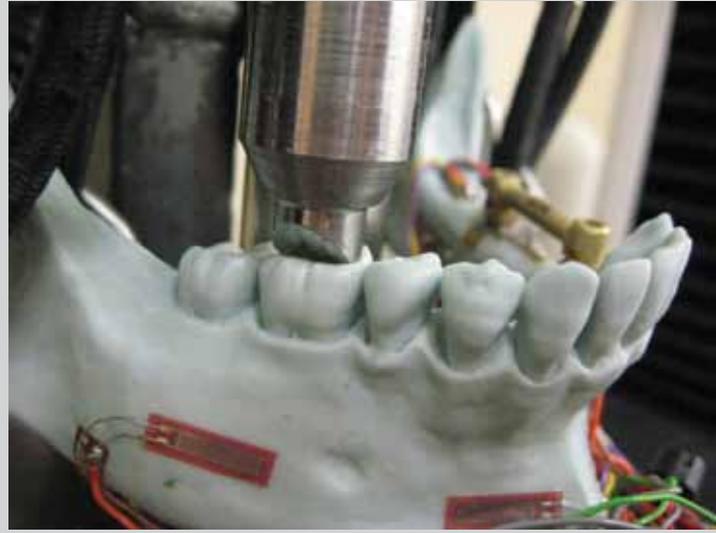
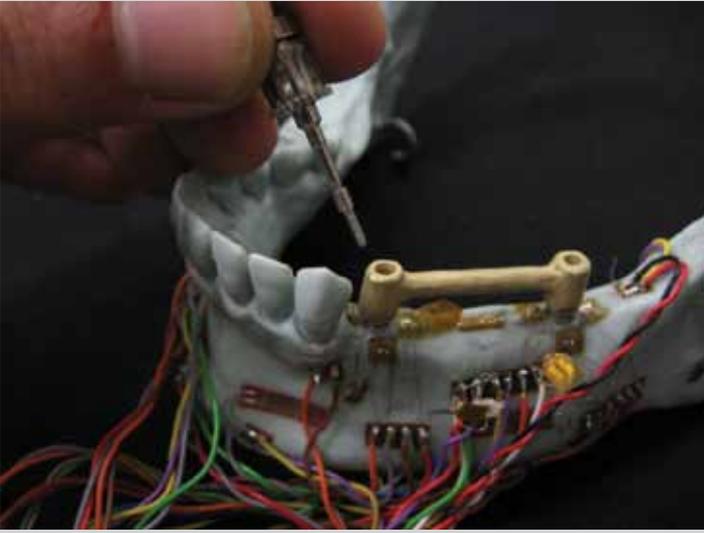
### 2011

*National Institute of Justice USA.* Development of a new model to study firearms related bloodspatter (Jules Kieser with Michael Taylor, ESR) US\$74,357.

*Lottery Health Research Shared Equipment Grant.* ARG-G2 magnetic bearing rheometer (E13/230861) (Programme members with Natalie Medicott and Thomas Rades) \$56,000.

*New Zealand Dental Research Foundation.* Continuous measurement of salivary pH using a novel indwelling wireless intraoral pH telemetry (Mauro Farella and Jules Kieser) \$15 000.

*New Zealand Dental Research Foundation Continuing Dental Education Trust Research Award.* Is the mid-palate of edentulous elders suitable for wide-bodied implants supporting over dentures? A histomorphometric and micro-computerised tomography study of human cadavers (with Allahoudin Siddiqi, Warwick Duncan, Jules Kieser and Rohana De Silva ) \$7,000



## DENTAL EPIDEMIOLOGY AND PUBLIC HEALTH

Programme Director: Professor W. Murray Thomson

Our work has the two main strands of (1) dental epidemiological research and (2) dental health services research. *Dental epidemiological research*: in this work, 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. Multidisciplinary collaboration has proven to be a very fruitful way of doing our work, in that it combines the different strengths and knowledge bases of a number of researchers. *Dental health services research (HSR)*: this work is concerned with how the dental healthcare system works, 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 have played an important role in the development and epidemiological validation of new measures for child oral-health-related quality of life, working in collaboration with a number of overseas researchers. We also conduct dental workforce research. 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).

### KEY PERSONNEL AND COLLABORATIONS

Professor WM Thomson

Professor JR Broughton

Dr JM Broadbent

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

Dr J Zeng (funded by an HRC programme grant; biostatistician; from 2013)

Dr LA Foster Page

Dr KC Morgaine

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), Australia (the Universities of Adelaide and Melbourne), Canada (the University of Toronto), Japan (Osaka University), 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 (University of Santa Catarina, Florianopolis).

### CURRENT RESEARCH

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

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

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

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

*Outcomes during 2011-12*: Work in this area continues to attract international attention and to be published in the top international journals: 13 papers were published, and a number of conference presentations were made. The age-38 assessments were successfully completed for 95% of the surviving cohort. The funded aims of the dental research component for age 38 are: (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.



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

*Aims:* Various – enhancement of the knowledge base for dental epidemiology, dental public health, and clinical practice.

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

*Outcomes during 2011-12:* 13 papers were published.

### Activity 3. Dental health services research

*Description:* Dental health services research in NZ, including ongoing, systematic dental workforce research.

*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 2011-12:* 25 papers were published (this total includes a number of clinical and educational research papers 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.

*Aims:* to build research capacity in our field.

*Outcomes during 2011-12:* successful postgraduate completions comprised seven Doctors of Clinical Dentistry and six Masters degrees. In addition, Dr JM Broadbent was a co-developer of the new BDS Honours programme Research Methods paper (DENT 580) in 2012.



## 2011-12 HIGHLIGHTS

### Papers published and conference presentations made

In total, 50 papers were published in the peer-reviewed international scientific literature. The total number of conference presentations made was 34. Full details are available online

### External funding secured

Approximately \$1.8 million (NZD) in external research funding was awarded to the Programme over the 2011-12 period. Of this, \$1.46 million was from the Health Research Council, while \$340,000 was secured in Ministry of Health research grants and contracts.

2012. Health Research Council of New Zealand – Programme Grant Extension. *The Dunedin multidisciplinary study of aging and risk for chronic disease.* To Professor WM Thomson, Professor Richie Poulton and Dr Nigel Dickson. \$5,665,540. 1 July 2012 to 30/06/2015. The dental project share of this grant is \$1,000,000.

2012. Ministry of Health Research Fund. *Living with dry mouth – Sjogren's syndrome patients' perspectives.* To Professor WM Thomson, Ms Joanna Ngo, Associate Professor Anita Nolan and Dr Shelagh Ferguson. \$NZ6,256.

2012. Ministry of Health Research Fund. *Dental professionals' experiences and perspectives on the provision of domiciliary oral health services for older adults.* To Professor WM Thomson, Dr Moira Smith (PI) and Associate Professor Kaye Roberts-Thomson. \$NZ14,000.

2011. Ministry of Health. *Improving oral self-care outcomes for at-risk adults.* To Professor WM Thomson (PI), Dr RP Fitzgerald (Anthropology) and Associate Professor JR Broughton (Social and Preventive Medicine). NZ\$264,881.

2011. Ministry of Health Research Fund. *A novel approach to caries management in children by resin infiltration.* To Dr L Foster Page (PI), Professor WM Thomson, MV Swain, D Schwass and AM Meldrum. \$NZ54,587.

2011. Health Research Council of New Zealand. *Oranga niho me ngā tangata whaiora: Oral health of Māori mental health patients.* To Professor JR Broughton, MG Lawrence, M Steinmann, M McGibbon, R Downs, J Nichols, B Laing, V Anderson. \$NZ293,000.

2011. Health Research Council of New Zealand. *A novel approach to caries management in New Zealand children.* To Dr Lyndie Foster Page (PI), Professor WM Thomson, Ms Dorothy Boyd and Dr Nicola Innes (University of Dundee). \$NZ146,826.

### Postgraduate student completions 2011-12

Doctor of Clinical Dentistry: Guo Ling, Luke Adsett, Giselle D'Mello, Rohaida Abdul Halim, Lutfiya Al-Harathi, Praema Suppiah, Ali Ukra.

Master of Community Dentistry: Haji Amirul Rizan Bin Haji Mohamed, Victoria McKelvey, Angela Benn, Elizabeth Hitchings.

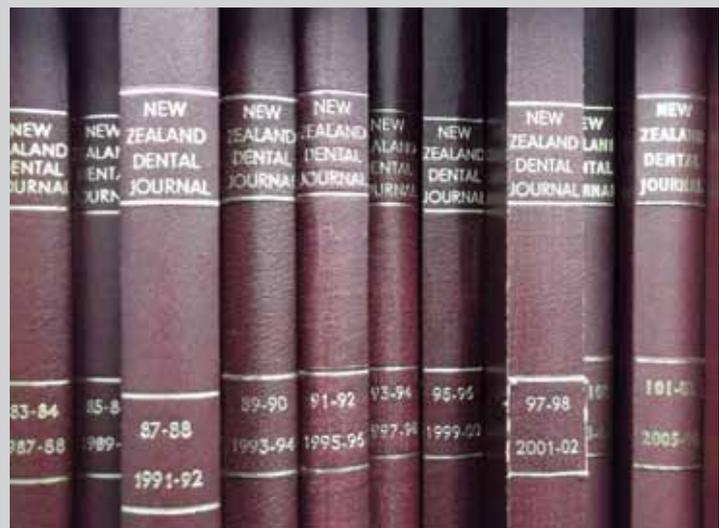
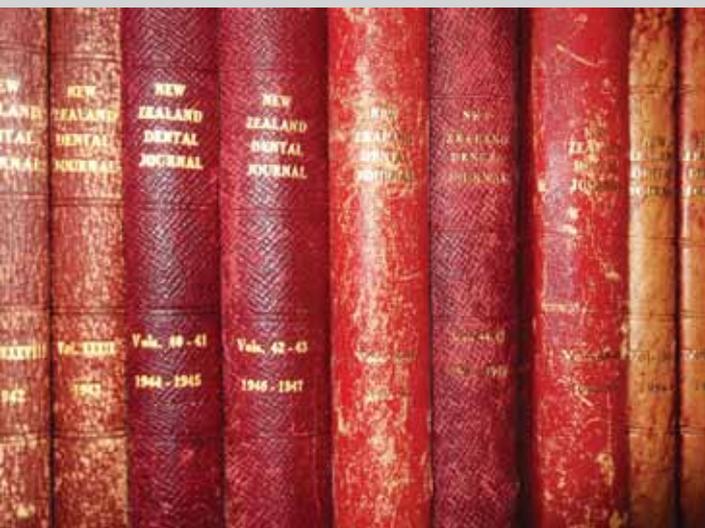
Other Masters: Yoganathan Ponnambalam, Jayaram Subramanian

### Honours/awards

Lyndie Foster Page received the Young Investigator Award in Preventive and Community Dentistry from the Australia-New Zealand Division of the International Association for Dental Research in 2011.

Kate Morgaine was awarded the Sir John Walsh Research Institute Director's Award: Student Research Mentor Award in 2011.

Jonathan Broadbent was awarded the NZ Dental Association's Outstanding Young Dentist Award for 2011-12.



## EDUCATION RESEARCH

Programme Director: Prof Tom Kardos

Research within this theme aims to contribute to knowledge and understanding of education, and to improve the quality of undergraduate and postgraduate educational experiences in the Faculty. A number of individuals have included research into aspects of education as part of their academic portfolios, in order to meet several of the University's core values and strategic imperatives i.e. achieving excellence in research and teaching in addition to facilitating outstanding campus environments and student experiences.

### Dental Education Support Officer:

2011 Dr Vivienne Anderson

2012 Dr Janet Rountree

### CURRENT RESEARCH PROJECTS

Prof. A. Rich, Dr J. Rountree, Prof. G. Seymour, (University of Otago), Dr D. Lekkas, A/Prof. T. Winning and Prof. G. Townsend, (The University of Adelaide).

*Do multifaceted admission processes predict performance of students in two Australasian dental programmes?* \$100,000

Dr S. Gallagher, Dr J. Rountree, Prof. B. Drummond, Dr J. Millichamp and Dr M. Stubbe, (University of Otago). University of Otago Teaching Development grant

*Developing reflective practitioners through online video-based self-reflection.* \$20,035

Dr V. Anderson, Dr P. Koopu, Mr G. Keay, Prof. A. Rich and Prof. J. Broughton: Ministry of Health Oral Health Research Fund grant.

*Oranga niho, oranga tinana, oranga whānau: What are the implications of final-year dental student outplacements with Māori Oral Health Providers for students, hosts and whānau?* \$24,988.

Dr S. Ma, Dr A. Tawse-Smith and Prof. M. Thomson. CALT *New model of geriatric dental education.* \$1,987.

Dr S. Ma, Mr K. Loke and Ms G. Hesson. University of Otago, Committee for the Advancement of Learning and Teaching.

*A head in virtual reality: development of a 3D simulation mouth model.* \$2,576.

### PUBLICATIONS

He, L.-H., Foster Page, L. and Purton D. (2012). An evaluation of dental operative simulation materials. *Dental Materials Journal* 31: 645-649.

Subramanian, J., Anderson, V.R., Morgaine, K.C. and Thomson, W.M. (2012). Improving the quality of educational strategies in postgraduate education using student and graduate feedback: findings from a qualitative study in New Zealand. *European Journal of Dental Education*. Published online : 19 Sept. 2012, DOI: 10.1111/eje.12006

Subramanian, J., Anderson, V.R., Morgaine, K.C. and Thomson, W.M. (2012). Effective and ineffective supervision in postgraduate education: a qualitative study. *European Journal of Dental Education*. Published online: 12 Aug. 2012, DOI: 10.1111/j.1600-0579.2012.00774.x

Subramanian, J., Anderson, V. R., Morgaine, K. C. and Thomson, W. M. (2012). The importance of 'student voice' in dental education. *European Journal of Dental Education*. Published online : 12 Aug. 2012, DOI: 10.1111/j.1600-0579.2012.00773.x

Pang, L., Anderson, V. and Moffat, S. (2012). Initial University of Otago Oral Health graduates' employment pathways and preparedness for work. *New Zealand Dental Journal*, 108:83-88.

Anderson, V., Pang, L., and Aarts, J. (2012). New Zealand dental technicians and continuing education: Findings from a qualitative survey. *New Zealand Dental Journal*, 108:47-54.

Foster Page, L. A., Kang, M., Anderson, V. and Thomson, W. M. (2012). Appraisal of the Dundee Ready Educational Environment Measure in the New Zealand dental educational environment. *European Journal of Dental Education*, 16: 78-85.

Anderson, V., Kang, M. and Foster Page, L. (2012). First-year oral health and dentistry student perceptions of future professional work. *European Journal of Dental Education*, 16: e166-e173.

Moffat, S. and Kardos, R. (2012). New Zealand, Section 4. In, *A review of global literature on dental therapists*. Eds Nash, D.A., Friedman, J.W. and Mathu-Muju. K.R. Kellogg Foundation. Battle Creek, Michigan U.S.A. Pages 70-128.

Friedlander, L. and Anderson, V. (2011). A new predoctoral endodontic module: Evaluating learning and effectiveness. *Journal of Dental Education*, 75: 351-359.

Rich, A. M., Ayers, K. M. S., Thomson, W. M., Sinclair, R. J., Rohan, M. J. and Seymour, G. J. (2012). Does performance in selection processes predict performance as a dental student? *European Journal of Dental Education*, 16: 27-34.

Anderson, V., Rich, A. and Seymour, G. (2011). Undergraduate dental education in New Zealand: 2007-2009 final-year student feedback on clinical learning environments. *New Zealand Dental Journal*, 107: 85-90.

## VISITING COLLABORATORS

Professor Brian Jolly, Faculty of Medicine, Nursing and Health Sciences, Monash University, Melbourne

Professor Andrew I. Spielman, Professor of Basic Science and Craniofacial Biology, New York University College of Dentistry

Dr Mary E. Williard, Dental Health Aide Therapist Education Director, University of Washington DENTEX Training Center.

Dr Heli Vinkka-Puhakka, Department of Oral Disease, Faculty of Dentistry, University of Turku, Finland.



## MOLECULAR MICROBIOLOGY

Programme Director: Professor Richard Cannon

Oral microbes cause disease in a large proportion of the population. The research carried out under this programme aims to study the microorganisms responsible for a range of oral diseases, to understand how the diseases are caused, and to devise strategies to prevent them. The researchers use biochemical, molecular biological and microbiological techniques within a Physical Containment Level 2 (PC2) laboratory to investigate and ameliorate oral and other microbial diseases.

In 2011-2012, the Molecular Microbiology programme was funded from the following sources: the National Institutes of Health (USA), the Ministry of Education (China), the Marsden Fund of the Royal Society of New Zealand, the Foundation for Research Science and Technology, the Maurice and Phyllis Paykel Trust, the Ministry of Health Oral Health Research Fund, the New Zealand Dental Association Research Foundation, Otago Innovation Ltd, the Otago Medical Research Foundation, and the University of Otago Research Committee.

### KEY PERSONNEL AND COLLABORATORS

#### Staff

Professor Richard Cannon  
 Dr Nick Heng  
 Dr Ann Holmes  
 Dr Mikhail Keniya  
 Dr Erwin Lamping  
 Professor Robert Love  
 Professor Karl Lyons  
 Dr Li Mei  
 Dr Brian Monk  
 Dr Kyoko Niimi  
 Dr Masakazu Niimi  
 Dr Geoff Tompkins  
 Mrs Jenine Upritchard

#### Postgraduate Students

Marina Mohd Bakri	Sujan Gowda
Leanne Hou	Franziska Huschmann
Darnell Kennedy	Nick Knight
Yeen Lim	Reza Shah Mansouri
Juhi Muthuplackal	Kate Newsham-West
Albert Nguyen	Yaya Othman
Bikiran Pardesi	Rohan Rodricks
Ely Rodrigues	Alia Sagatova
Don Schwass	Madhu Shankar
Wan Syasliza	Langley Tasmania
Varayini Yoganathan	

#### Visiting Scientists and students

Professor Bernhard Hube  
 Hans Knoell Institute Jena (HKI) Jena, Germany

Professor Susumu Kajiwara  
 Tokyo Institute of Technology, Tokyo, Japan

Dr Amarila Malik  
 Universitas Indonesia, Depok, Indonesia

Professor Rajendra Prasad  
 Jawaharlal Nehru University New Delhi, India

Professor Ted White  
 University of Missouri, Kansas, USA

Dr Egija Zaura  
 Academic Centre for Dentistry, Amsterdam

Ms Rouyu Zhang  
 Tokyo Institute of Technology, Tokyo, Japan

#### External collaborators

Dr Stewart Bisset  
 AgResearch, Palmerston North

Professor Henk Busscher  
 University of Groningen, the Netherlands

Associate Professor Hiroji Chibana  
 Chiba University, Chiba, Japan

Dr Edmund Fleischer  
 MicroCombiChem, Weisbaden, Germany

Dr Anette Klinger  
 MicroCombiChem, Weisbaden, Germany

Professor Andre Goffeau  
 Universite catholique de Louvain, Brussels, Belgium

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 Hironobu Nakayama  
 Suzuka University of Medical Sciences, Mie, Japan.

Drs Christine Seers and Catherine Butler  
 University of Melbourne, Australia

Dr Jan Schmid  
 Massey University, Palmerston North

Professor Larry Sklar  
University of New Mexico, Albuquerque, USA

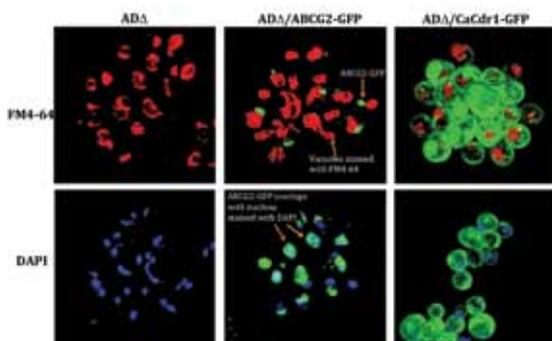
Professor Robert Stroud  
UCSF, San Francisco, USA

Dr Koichi Tanabe  
National Institute of Infectious Diseases, Tokyo, Japan

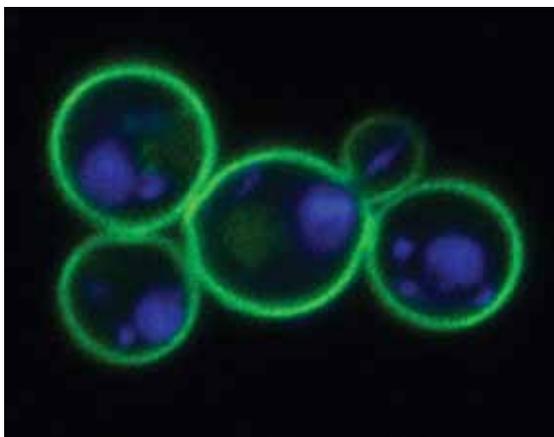
Dr Thomas Tomasiak  
UCSF, San Francisco, USA

Dr Keigo Ueno  
Chiba University, Chiba, Japan

Dr Silas Villas-Bôas  
University of Auckland, Auckland



Human ABC transporter ABCG2 is located near the nucleus of yeast cells (DNA stained blue with DAPI) and is not in the vacuole (stained red with FM6-64). *C. albicans* ABC efflux pump Cdr1p is not associated with the nucleus or vacuole but is located in the plasma membrane (S Gowda, PhD student)



Yeast multidrug efflux pump Pdr5p (tagged with GFP) is located in the plasma membrane (DNA stained blue with DAPI; Dr M Keniya)

## CURRENT RESEARCH PROJECTS

There are several projects within the molecular microbiology programme.

One project is investigating how periodontal bacteria acquire the haem they require for growth, as preventing this access may help prevent periodontal disease.

A group is investigating how bacteria colonize and invade dentinal tubules, which can lead to endodontic infections. Other researchers are developing an ex vivo model for assessing the efficacy of endodontic disinfection regimens.

People possess unique oral microbial microbiota that are relatively stable. One research project is investigating whether criminals could be identified from unique patterns of bacterial DNA left on victims following bite mark injuries.

A research team is using next-generation DNA sequencing technology to analyse the bacterial diversity associated with oral health and disease (severe dental caries and periodontal disease).

Next-generation DNA sequencing is also being used to sequence the genomes of two oral bacterial species: (i) an antimicrobial-producing strain of *Streptococcus salivarius*, and (ii) a strain of a new species, *Streptococcus trichosurus*, isolated from the oral cavity of the New Zealand-adapted brushtail possum *Trichosurus vulpecula*. The projects are currently in the genomic gap closure phase.

Proteins bearing the pathogenesis related domain (PRD) are involved in the immune response of plants, human reproduction, brain tumours and the production of marine toxins, but the molecular basis of their function is unknown. The Tex31 protein is being studied as a representative PRD protein to test the hypothesis that the PRD domain has a novel protease activity.

A major research focus is on the oral fungi that cause mucosal and systemic infections. One research team has discovered major mechanisms of clinically relevant azole and echinocandin resistance in oral fungi and is currently screening for drugs to overcome azole resistance. The drug screening platform is also being applied to other, novel, antifungal drug targets and to drug targets implicated in other human diseases and parasitic nematodes.

Overexpression of ABC protein Cdr1p is a major contributor to azole antifungal drug resistance in clinical *C. albicans* isolates yet little is known about its substrate specificity and pump function. A comprehensive biochemical and structural analysis of Cdr1p has resulted in a model indicating regions of the pump that interact with key substrates and inhibitors.

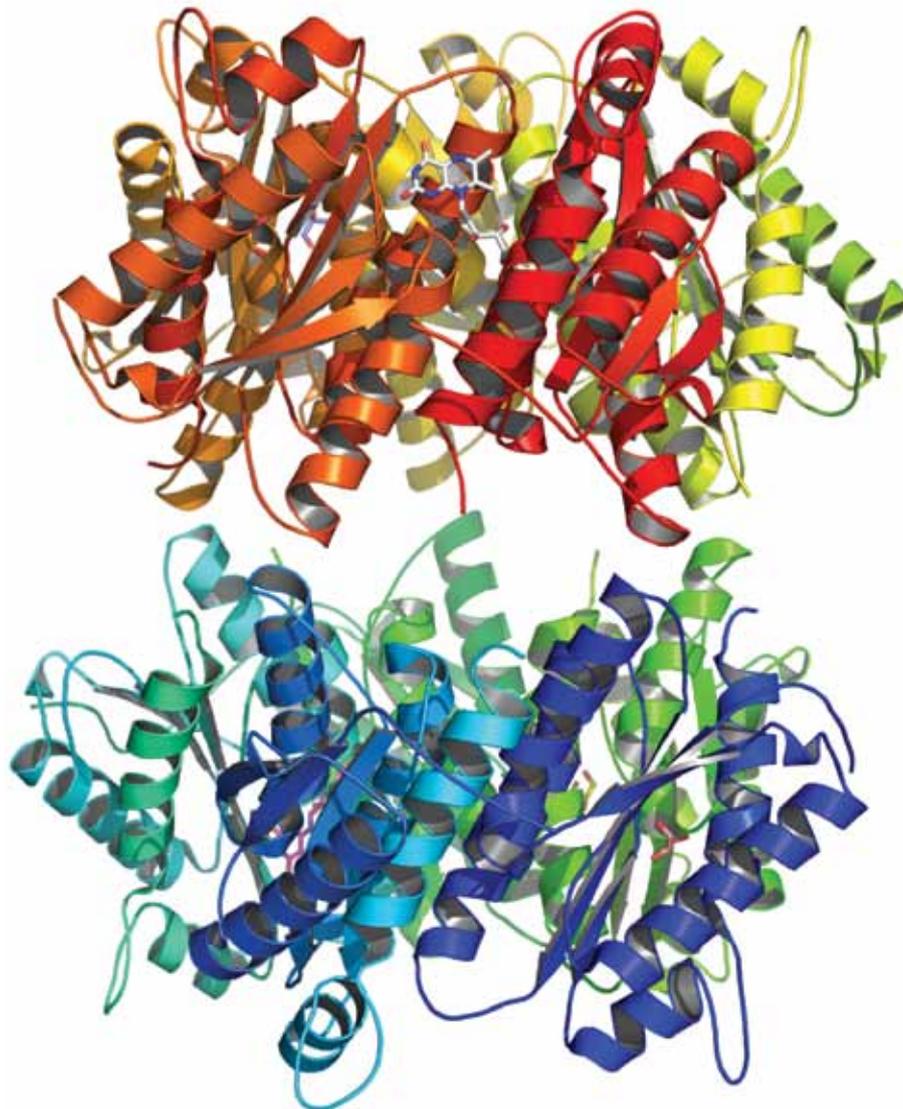
Human ABC transporters are responsible for the drug resistance of some tumour cells. To study their drug efflux properties, a research team has expressed them in the yeast *Saccharomyces cerevisiae*. The team is focusing on improving the expression of human ABC transporters in yeast strains so that they can be used for functional analysis and in high-throughput screening for drug discovery.

Another research theme is microbial adhesion. One project is investigating the microorganisms that adhere to prostheses used as obturators for maxillary resections. Another project is looking at the role of salivary proteins in oral microbial adhesion. A further project is investigating whether antibodies raised against the human

pathogen *Candida albicans* can be used to prevent *C. albicans* adhesion.

In collaborations with researchers in the Netherlands and China, the adhesion of oral bacteria to orthodontic materials, and ways of improving oral hygiene in orthodontics patients, is being studied.

*C. albicans* was thought until recently to be a diploid fungus that does not undergo sexual reproduction. A research group within the programme has discovered, however, that *C. albicans* strains can mate in an animal model of oral colonization. The group is testing whether the offspring can out-compete their parents.



X-ray crystal structure of recombinant enzyme lumazine synthase from the fungal pathogen *Candida glabrata* complexed with the product of catalysis. This enzyme is an essential component of the riboflavin biosynthetic pathway ifound in fungi and a potential drug target (Madhu Shankar, PhD student).

## 2011-12 HIGHLIGHTS

### **Student graduations**

Marina Bakri (PhD, 2011)

Leanne Hou (DClinDent, 2012)

Karl Lyons (PhD, 2012)

Reza Shah Mansouri (DClinDent, 2012)

Albert Nguyen (PhD, 2011)

Rohan Rodricks (DClinDent, 2011)

Langley Tasmania (DClinDent, 2012)

Manjula Weerasekera (PhD, 2012)

Varayini Yoganathan (DClinDent, 2012)

### **Honours and awards**

Ceridwen Benn (4th year dental student) won the International Association for Dental Research (IADR), New Zealand Section Colgate Poster Competition (2012)

Professor Richard Cannon: IADR, Australia and New Zealand Division, Alan Docking Science Award (2011)

Professor Richard Cannon: Sir John Walsh Research Award (2011)

Grace Lee (5th year dental student) won first prize in the Hatton Awards at the IADR General Session, San Diego (2011)

Dr Kyoko Niimi, SJWRI Basic Research Award (2010, awarded in 2011)

Dr Masakazu Niimi, Poster Prize, International Society for Human and Animal Mycology, 18th Congress, Berlin, Germany (2012)

Daniel Sundaresan (5th year dental student) won first place in the Otago Medical School Research Society (OMSRS) student speaker awards (2012)



## ORAL MOLECULAR AND IMMUNOPATHOLOGY

Programme Directors: Professors Greg Seymour and Alison Rich

The main objective of our group is to explore the cellular and molecular basis of oral diseases, so as to improve their diagnosis and treatment. The group has three major themes: (i) periodontal diseases, (ii) oral mucosal disease including oral squamous cell carcinoma, and (iii) tissue regeneration. In this context, a range of cellular, molecular, immunological and pathological tools are employed including cell culture, genomic and focused micro-arrays, real-time PCR, laser microdissection and immunohistochemistry. In terms of periodontal disease the focus is on understanding the immunoregulatory control of chronic periodontitis and on epigenetics to determine the influence of environmental factors, such as tobacco smoking, on disease progression. The relationship with systemic diseases is being investigated as part of a multidiscipline international collaborative study, while the immunopathological mechanisms underpinning oral mucosal diseases are being investigated using single and double layer immunofluorescence and immunohistochemistry coupled with the use of focused micro-arrays to determine gene expression profiles. Of major interest is regulation of the local immune response in oral mucosal lichen planus and in oral squamous cell carcinoma and angiogenesis and the reaction to endoplasmic stress in carcinoma. The interest in angiogenesis also extends to pulpal tissues in terms of root development, as well as to the effect of bisphosphonates and the pathogenesis of Bisphosphonate Related Osteonecrosis of the Jaw (BRONJ). In collaboration with the oral implantology research group, immunohistology and gene expression approaches are being used to determine the effect of implant surface type and morphology on the osteogenic potential of adipose-derived stem cells as well as other cell types in culture.

### KEY PERSONNEL AND COLLABORATIONS

Praveen Parachuru	Suraya Sinon
Dawn Coates	Avadhoot Avadhani
Stephanie Park	Diogo Zaniccotti
Olive Allsobrook	Trudy Milne
Mary Cullinan	Warwick Duncan
Norman Firth	Andrew Tawse-Smith
Lara Friedlander	Bernadette Drummond
Osea Gavidì	Alison Rich
Sharla Kennedy	Benedict Seo
Haizal Hussaini	Greg Seymour
Ramya Jawadi	Sobia Zafar
Lynda Home	Sarah Drake
Simon Guan	Muhammad Al-Ansary

We have international collaborative studies with the Oral Cancer Research and Coordinating Centre, University of Malaya, Malaysia, the School of Medicine of the University of Queensland, Australia, the School of Dentistry, Niigata University, Japan, and a developing collaboration with the University of Sheffield.

In association with the School of Medicine University of Queensland, the group is conducting a major 5 year longitudinal clinical study on the relationship between periodontal and cardiovascular diseases. This study has attracted over \$3 million in funding over the past 5 years and as a result the group is considered a world leader in this field. The group is also recognized as a world leader in using molecular and cellular techniques in longitudinal clinical trials.

### CURRENT RESEARCH PROJECTS

*Characterisation of natural regulatory T cells and Th17 cells in human periodontal disease and oral squamous cell carcinoma.* H Hussaini, P Parachuru, D Coates, T Milne, M Cullinan, A Rich, G Seymour. Funding: \$36,905 NZDARF 2010-2012, \$12,444 OMRF 2010-2012

*Endoplasmic stress in periodontal diseases and oral squamous cell carcinoma.* B Seo, D Coates, A Rich, G Seymour. Funding: \$29,810 NZDARF 2010-2012

*Regulation of the immune response in oral mucosal lichen planus.* S Sinon, R Jawadi, F Firth, A Rich, G Seymour. Funding: \$14,981 NZDARF 2012

*Human adipose-derived stem cells on titanium surfaces and the pathogenesis of peri-implantitis.* D Zaniccotti, A Tawse-Smith, D Coates, W Duncan, G Seymour. Funding: \$14,397 NZDARF 2011-2013

*The role of bisphosphates on gingival fibroblast gene expression.* S Zafar, M Cullinan, G Seymour. Funding: \$58,660 NZDARF 2011-2012

*Pulpal stem cells and angiogenesis in the pulp.* L Friedlander, M Cullinan, D Coates, A Rich, G Seymour. Funding: \$14,867 NZDARF 2010-2012

*Angiogenic factors in oral squamous cell carcinoma.* O Allsobrook, A Rich, L Friedlander, P Parachuru, G Seymour. Funding: \$14,422 NZDARF 2012-2014

## HIGHLIGHTS 2011-2012

### Sept 2012

Fiona Firth won the Junior Category of the Colgate-Palmolive Award in Dental Research and Sobia Zafar was second in the Senior Category at the meeting of the Australia and New Zealand Division of the International Association of Dental Research in Fiji.

### Aug 2012

Dr Benedict Seo won the International Association of Oral Pathology Oral Prize for his paper 'Endoplasmic reticulum stress and Russell bodies in periodontal inflammation' at the biennial meeting in Brazil.

### July 2012

Olive Allsobrook and Benedict Seo were awarded 'Young Investigator Travel Awards' by the International Association of Oral Pathology for travel to the biennial meeting in Brazil.

### July 2012

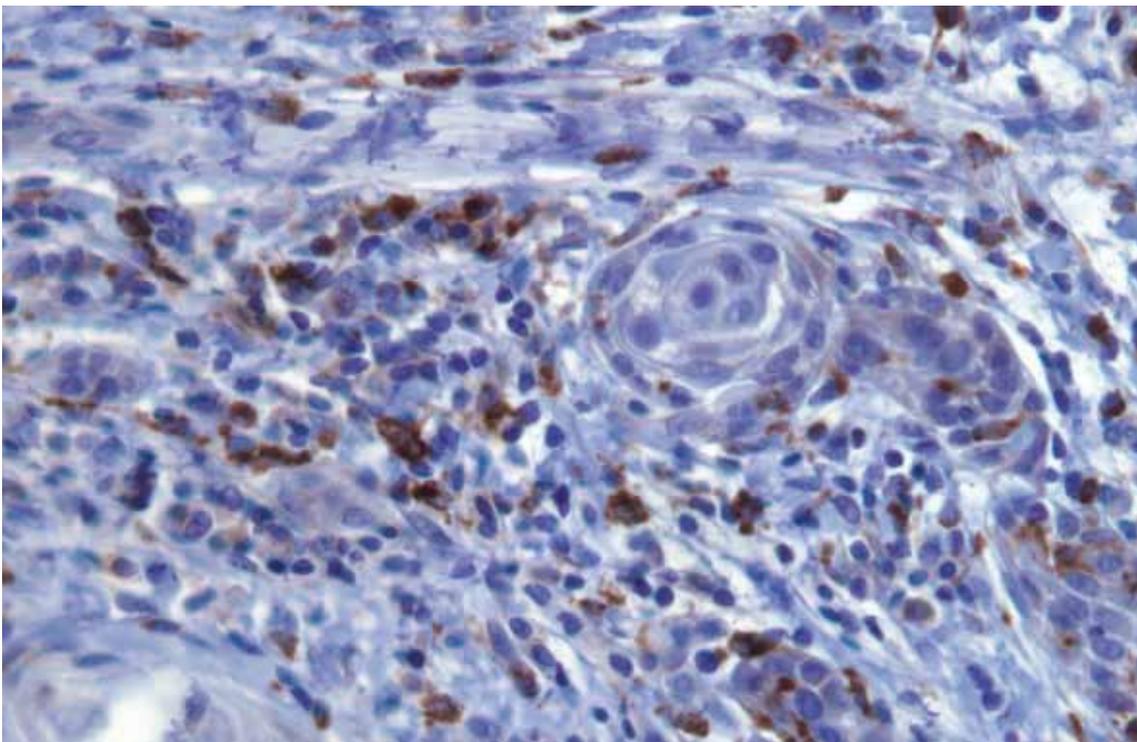
Dr Benedict Seo was awarded an Elman Poole Travelling Fellowship from the University of Otago to fund a visit to our collaborators in Malaysia to obtain experience with specific research techniques and collect additional research specimens.

### June 2012

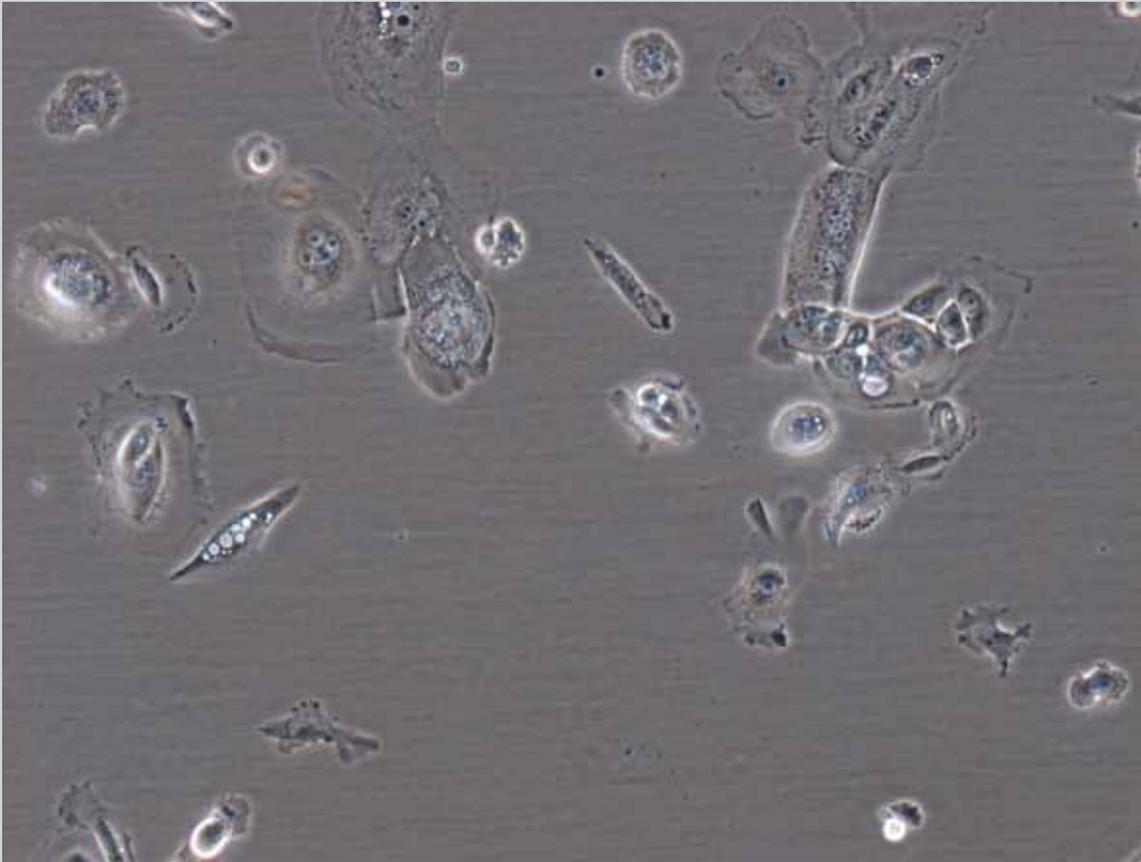
Associate Professor Mary Cullinan was appointed Chair of the International Association of Dental Research Awards Review Committee with responsibilities for judging the IADR/Unilever Hatton Competition and selecting recipients of the IADR/Colgate Research in Prevention Travel Award.



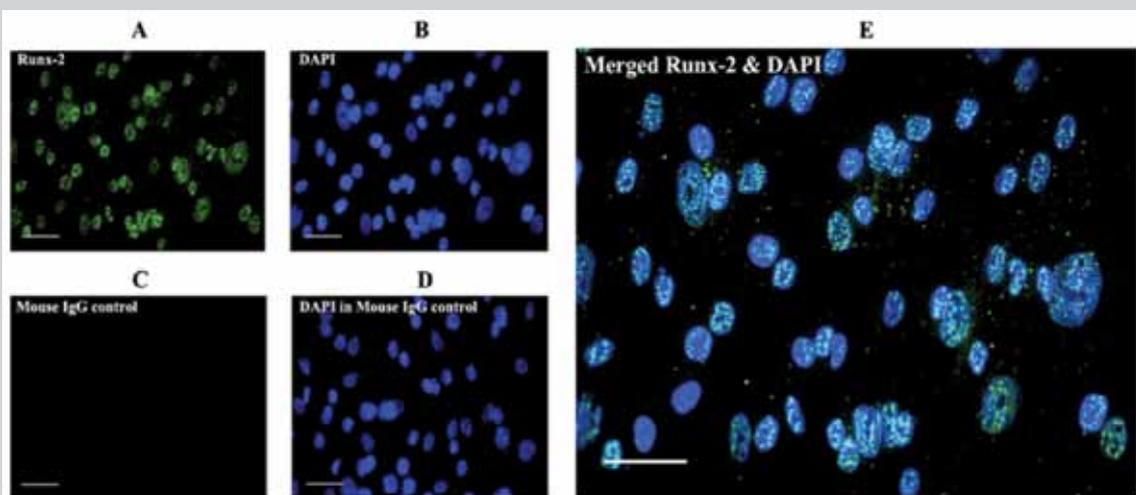
Greg Seymour, Ramya Jawadi, Alison Rich and Praveen Parachuru gathered together to assess slides of oral mucosal lichen planus processed for immunohistochemistry with antibodies to IL-33.



Macrophages reacting with CD68 in the stroma adjacent to infiltrating squamous cell carcinoma islands in an assessment of the immune response in oral cancer being undertaken as part of Avadhoot Avadhani's PhD project



Squamous cell carcinoma cell line cultured as part of Benedict Seo's PhD project prior to stimulation with tunicamycin to induce endoplasmic reticulum stress



Adipose-derived stem cells cultured by Diago Zanicotti in serum-free and osteogenic media expressed Runx-2 at 7 days on rough and smooth titanium surfaces. Expression of Runx-2 at 7 days on smooth titanium and serum-free media. Scale bar = 25 $\mu$ m

## CLINICAL RESEARCH

### AN EMERGING RESEARCH PROGRAMME OF THE SJWRI

Programme Director: Associate Professor Mary Cullinan

In late 2012 The Sir John Walsh Research Institute was successful in its application as a Research Centre within the University of Otago. This has enabled us to set up a Clinical Research Programme (CRP) within the Institute. The Clinical Research Programme aims to bring together clinical researchers and foster clinical research within the school. One of the first initiatives of the CRP is to develop a Practice Based Research Network (PBRN), which will reach out to dental practitioners throughout New Zealand.

PBRNs foster relationships between practitioners and academics by investigating research questions of relevance to daily clinical practice. The types of studies that may be undertaken range from retrospective studies using dental records, observational studies of routine care, case-control studies, through to clinical trials.

PBRNs have been successfully operating in a number of countries in recent years. For example, the US has the National Dental Practice-Based Research Network with a mission 'To improve oral health by conducting dental practice-based research and by serving dental professionals and their patients through education and collegiality'. Research carried out through PBRNs in the US has examined a range of topics including outcomes of cracked teeth and of single tooth endodontic and restorative treatment, repair or replacement of defective restorations, remineralisation of white spot lesions following removal of orthodontic brackets, and medications and dry mouth among others.

In 2011, the Victorian Branch of the Australian Dental Association in conjunction with the Oral Health Cooperative Research Centre of the University of Melbourne set up a PBRN named eViDent. Some of the projects undertaken by eViDent members include a retrospective study on implant complications in private practice, general practice prescribing and xerostomia, molar/incisor hypomineralisation, and periodontal diagnosis, treatment and maintenance in general practice.

PBRNs foster relationships between practitioners and academics by investigating research questions of relevance to daily clinical practice. The types of studies that could be undertaken in New Zealand range from retrospective studies using dental records, observational studies of routine care, case-control studies, clinical trials and other issues of relevance to dentists here in New

Zealand. PBRN practitioners in the US and Australia feel the experience offers them benefits in terms of improving patient care, providing collegiality and learning opportunities, and that they can give something back to the profession. Many are enthusiastic about the experience and find it empowering. They find that patients are also willing to participate in something that will improve treatments and outcomes.

PBRNs offer benefits in terms of improving patient care and providing collegiality and learning opportunities for members. A symposium is planned for June 2013 to introduce the concept of PBRNs to New Zealand dental practitioners and links with several international PBRNs have been initiated. The group is also offering scholarships to support postgraduate clinical research.





## DR LIHONG (CHRIS) HE

7 September 1978 – 19 November 2012

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Chris tragically died in a bicycle accident on the 19th of November 2012.

In 2009, Chris started his lecturing career at The University of Otago and in his few years here he became a popular lecturer amongst his students and a valued research partner and friend to many.

Between 1995 and 2002 he completed his BDS and MDS dental training at West China University of Medical Sciences. He completed his postgraduate DDS training at Sichuan University in 2005, where he specialised in prosthodontics.

He received a scholarship and went to Australia to complete his PhD at the University of Sydney in 2008.

Chris was passionate about his research, and very interested in human enamel. He was one of the first people to report on the influence of the hierarchical microstructure of human enamel on its micro-mechanical properties. His work has been internationally recognised with a citation record of well over 200.

His research interests included the evaluation of nano-mechanical behaviour of dental hard tissues and mechanical evaluation of clinical dental materials from which he published 33 refereed journal articles as well as 3 book chapters between 2005 and 2012.

He spent most of his free time with his young family and enjoyed fishing with his friends. He really appreciated the natural beauty of New Zealand and took every opportunity to experience and explore new places.

His passing is a huge loss to his family, friends and dental community.





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