UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

Sir John Walsh Research Institute

Research Report 2019-2020

Appendix: Our achievements

The SJWRI Research Report 2019-2020 is available to view and download from our website: www.otago.ac.nz/sjwri.

Direct download link for the Report:
www.otago.ac.nz/sjwri/otago835414.pdf

Full listing of SJWRI research publications, 2019-2020

All publications from authors with SJWRI or Faculty of Dentistry affiliations, listed by year (2020, then 2019). All data courtesy the PBRF and Publications Office, Research Division, with thanks to Molly McCormick, Research Outputs Administrator.

Chapter in Book - Research

Bogen, G., & Chandler, N. P. (2019). Vital pulp therapy. In I. Rotstein & J. I. Ingle (Eds.), Ingle's endodontics 7: Volume 1. (pp. 885-909). Raleigh, USA: PMPH USA.

Journal - Research Article

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Abdullah, R., Olson, H., Todd, G., & Tong, D. (2020). Oral health perceptions, attitudes and knowledge among intensive care nursing staff in a tertiary hospital. Australian & New Zealand Journal of Dental & Oral Health Therapy, 8(1), 15-18.

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Conference Contribution - Poster Presentation (not in published proceedings)

Madani, G. (2019, August-September). Expression, purification, and negative staining of Candida albicans plasma membrane protein Cdr1. Poster session presented at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Conference Contribution - Verbal presentation and other Conference outputs

Beckett, D. (2020, December). Wax carving online you say? Ummmm? Verbal presentation at the College of Oral Health Academics (COHA) Virtual Conference: Going Viral, Online.

Broadbent, J. (2020, December). Men's oral health. Verbal presentation at the Men's Health Colloquium: Advancing Advocacy to Enhance Men's Health in NZ, Dunedin, New Zealand.

Heng, N. (2020, December). Experiences of a 'virtual microbiology practical': Zoom-based lectures and online tests. Verbal presentation at the College of Oral Health Academics (COHA) Virtual Conference: Going Viral, Online.

Olson, H. (2020, December). Enquiry-based learning with student engagement through collaboration and reflection. Verbal presentation at the College of Oral Health Academics (COHA) Virtual Conference: Going Viral, Online.

Thomson, W. M. (2020, September-October). Polypharmacy and medication-induce dry mouth in a national sample of dependent older New Zealanders. Verbal presentation at the Vision for Ageing in Aotearoa Conference, Wellington, New Zealand.

Abdelmoneim, D., Cotton, G. C., Duncan, W. J., Jude, A., Gee, C., & Coates, D. E. (2019, August-September). Efficacy and safety of alpha lipoic acid-capped silver nanoparticles for oral application. Verbal presentation at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Al Naasan, Z. (2019, November). We know the problems, let's find the solutions: Promoting oral health among Syrian former refugees. Verbal presentation at the Migration, Health and Wellbeing Conference, Dunedin, New Zealand.

Coates, D. E., Alansary, M., Dong, Z., Godoy Zanicotti, D., Naung, N. Y., & Duncan, W. J. (2019, August-September). Stem cells for regenerative medicine in dentistry. Verbal presentation at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Dong, Z., Haines, S., Milne, T., & Coates, D. (2019, August-September). Identification of stem cell biomarkers using deer antler as a model of mammalian organ regeneration. Verbal presentation at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Duncan, W. J. (2019, August-September). Regeneration for dental implant therapy: Clinical requirements and preclinical models. Verbal presentation at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Lyons, K. (2019, April). Management of the maxillofacial prosthodontic patient: A multidisciplinary approach to treatment [International plenary]. Verbal presentation at the 21st Indian Prosthodontic Society Post Graduate (IPSPG) Convention, Visnagar, India.

Lyons, K., & Patil, P. G. (2019, April). Restoration of maxillary defects: From pre-surgical considerations to delivery of the definitive obturator. Invited presentation at the 21st Indian Prosthodontic Society Post Graduate (IPSPG) Convention Preconvention Course, Visnagar, India.

Madani, G. (2019, April). Towards an understanding of azole antifungal drug resistance in Candida albicans. Invited presentation at the DAAD (Deutscher Akademischer Austauschdienst) PhD Colloquium, Dortmund, Germany.

Madani, G., Lamping, E., Bostina, M., Raunser, S., Hall, N., Mitra, A., & Cannon, R. D. (2019, September). Expression, purification, and negative staining of Candida albicans plasma membrane protein Cdr1. Verbal presentation at the Sir John Walsh Research Institute Research Day, Dunedin, New Zealand.

Monk, B. C., Sagatova, A. A., Wilson, R. K., Tyndall, J. D. A., Lackner, M., Ruma, Y. N., Hosseini, P., & Keniya, M. V. (2019, August-September). Drug discovery using the antifungal target lanosterol 14α-demethylase. Verbal presentation at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Prasad, S., Paulin, M., Cannon, R., & Farella, M. (2019, August-September). Monitoring masticatory muscle activity by a smart-phone assisted wearable device. Verbal presentation at the Queenstown Molecular Biology (QMB) Meetings, Queenstown, New Zealand.

Thomson, W. M. (2019, June). Clinical assessment II-xerostomia and polypharmacy. Verbal presentation at the International Association for Dental Research (IADR), American Association for Dental Research (AADR), & Canadian Association for Dental Research (CADR) General Session, Vancouver, Canada.

Commissioned Report for External Body

Barker, M., Bridgman, J., Carrington, S., Fuge, K., Gillingham, W., Gray, J., & McKelvey, D. (2020). Guidelines for oral health services at COVID-19 Alert Level 1. Wellington, New Zealand: Ministry of Health and Dental Council. 14p. Retrieved from https://www.dcnz.org.nz/covid-19/guidelines-for-oral-health-services-at-covid-19-alert-levels/.

Working Paper; Discussion Paper; Technical Report

Larcombe, M., Coleman, M., Stokes, T., Cannon, R., Lübcke, A., & Smith, S. (2020). Impacts of research. Dunedin, New Zealand: Division of Health Sciences, University of Otago. 68p. Retrieved from http://hdl.handle.net/10523/10173.

Towle, I., Irish, J. D., De Groote, I., & Fernée, C. (2019). Dental caries in human evolution: Frequency of carious lesions in South African fossil hominins. bioRxiv. doi: 10.1101/597385

Technical/Scientific Report

Smith, M. B., Ferguson, C. A., & Thomson, W. M. (2019). Public sector oral health service provision for high needs and vulnerable New Zealanders. Wellington and Dunedin, New Zealand: Health Promotion and Policy Research Unit and Sir John Walsh Research Institute. 197p.

Other Research Output

Invited Presentation

Carrington, S. (2019, September). Common oral pathology lesions and their management in children and adults: A review for oral health therapists, dental therapists and dental hygienists. New Zealand Dental Hygienists' Association (NZDHA) and New Zealand Dental and Oral Health Therapist Association (NZDOHTA) Palmerston North Roadshow, Distinction Hotel, Palmerston North, New Zealand.

Carrington, S. (2019, September). Common oral pathology lesions and their management in children and adults: A review for oral health therapists, dental therapists and dental hygienists. New Zealand Dental Hygienists' Association (NZDHA) and New Zealand Dental and Oral Health Therapist Association (NZDOHTA) Hawkes Bay Roadshow, Napier Conference Centre, Napier, New Zealand.

Awarded Doctoral Degree

See page A-29 for details of PhD and DClinDent theses awarded doctoral degrees in 2019-2020.

Full listing of SJWRI research contracts, 2019-2020

Competitive and commercial research funding commencing or awarded in 2019-2020

This listing includes all projects led by or involving SJWRI named investigators, including those led by other departments or institutions. Funding is in New Zealand dollars, GST exclusive. Awards are presented in chronological order of start date, grouped by funder. Data courtesy Lorraine Harris, Research and Enterprise.

All affiliations are SJWRI, University of Otago unless otherwise noted.

Funding body	Prtoject title	Named investigators	Awarded	Start	End
Cure Kids	A novel approach for monitoring eating behaviour in children	Mauro Farella Ghassan Idris Barbara Galland (Women's and Children's Health, OMS) Claire Smith (Women's and Children's Health, OMS) Rachael Taylor (Medicine, OMS) Christopher Robertson	$49,458	1 Jan 2019	31 Dec 2019
Fuller Scholarships in Dentistry	The psychological effects of malocclusion from adolescence to adulthood	Mauro Farella Grace Nichols	$5,000	1 Jan 2019	31 Dec 2020
Maurice and Phyllis Paykel Trust	Drug resistance in the emerging fungal pathogen *Candida auris*	Richard Cannon Erwin Lamping	$10,000	1 Jan 2019	31 Dec 2019
University of Otago Research Grant	Development of a novel bone graft material from waste bovine teeth for dental surgery applications	Peter Cathro George Subasinghe Dias (Anatomy) Jithendra Ratnayake	$11,490	1 Jan 2019	30 Jun 2020
University of Otago Research Grant	Investigation of pressure distribution in edentulous patients: Development and validation of simulation systems	Joanne Choi Sunyoung Ma Neil Waddell Peter Xu (University of Auckland)	$44,900	1 Jan 2019	31 Dec 2019
University of Otago Research Grant	Family functioning and oral-health-related quality of life among children following dental treatment under general anaesthesia.	Manikandan Ekambaram Murray Thomson	$8,060	1 Jan 2019	31 Mar 2022
University of Otago Research Grant	Development of 3D-printed crowns to enable non-invasive treatment of dental caries in primary teeth	Kai Chun Li Gemma Cotton	$57,000	1 Jan 2019	31 Dec 2019
University of Otago Research Grant	Dolphin teeth as a biomonitoring tool of heavy metal exposure	Carolina Loch Santos da Silva Catherine Kemper (SA Museum) James Palin (Geology) Karen Stockin (Massey University) Mark Taylor (Macquarie University)	$25,931	1 Jan 2019	30 Jun 2020
University of Otago Research Grant	Oral health knowledge and attitudes of carers of home-based dependent older people	Graeme Ting Moira Smith (Public Health, UOW)	$44,208	1 Jan 2019	30 Jun 2020
Leverhulme Trust (University of Kent subcontract)	Biorhythm of childhood growth	Carolina Loch Santos da Silva	$97,858	1 Jan 2019	31 Jan 2022
Colgate Palmolive Limited (NZ)	Cattle Bone Toothpaste?	Peter Cathro Guangzhao Guan Peter (Li) Mei Jithendra Ratnayake	$14,357	1 Apr 2019	30 Dec 2020
Colgate Palmolive Limited (NZ)	Sugar in your diet: *kino te pai!*, An evaluation of oral health outreach results and community impact	Carolina Loch Santos da Silva Deanna Beckett Richard Cannon	$9,380	1 Apr 2019	28 Feb 2020
Maurice and Phyllis Paykel Trust	Efficacy of electrolysed oxidising water as a cost-effective dental disinfectant	Geoffrey Tompkins Richard Cannon	$8,000	1 May 2019	30 Apr 2020
Colgate Palmolive Limited (NZ)	Changes in mineral density and nanomechanical properties of enamel white spot lesions	Manikandan Ekambaram Carolina Loch Santos da Silva Alison Meldrum	$15,000	1 Jun 2019	31 Oct 2021

Funding body	Prtoject title	Named investigators	Awarded	Start	End
University of Otago	Early Career Award 2019	Carolina Loch Santos da Silva	$5,000	1 Jul 2019	31 Dec 2020
NSC Ageing Well (University of Auckland subcontract)	NSC Ageing Well: through Eating, Sleeping , Socialising and Mobility (AWESSoM)	Moira Smith (Public Health, UOW) Rebecca Abey-Nesbit (Medicine, UOC) Ulrich Bergler (Medicine, UOC) Catherine Ferguson (Public Health, UOW) John Pickering (Medicine, UOC) Murray Thomson	$619,189	1 Aug 2019	31 Dec 2023
Health Research Council of NZ (HRC)	Structure-directed discovery of next-generation antifungals	Brian Monk Mikhail Keniya Joel Tyndall (Pharmacy) Rajni Wilson	$1,199,968	1 Aug 2019	31 Oct 2022
Health Research Council of NZ (HRC)	Novel methods of infant feeding in New Zealand - cause for concern or optimism?	Anne-Louise Heath (Human Nutrition) Jillian Haszard (Human Nutrition) Lisa Houghton (Human Nutrition) Alison Meldrum Rachael Taylor (Medicine, OMS)	$1,185,360	1 Sep 2019	31 Aug 2023
New Zealand Dental Research Foundation	A 3D bioprinter for stem cell research in Dentistry	Dawn Coates Karl Lyons Alison Rich William Early (Otago Polytech) Mauro Farella	$15,000	1 Sep 2019	31 May 2020
Maurice and Phyllis Paykel Trust	A 3D bioprinter for stem cell research in Dentistry	Dawn Coates Karl Lyons Alison Rich William Early (Otago Polytech) Mauro Farella	$10,000	1 Oct 2019	30 Sep 2020
Fuller Scholarships in Dentistry	Investigating the adequacy of oral health care knowledge content for geriatric patients in undergraduate nursing programmes in New Zealand	Paul Brunton Karl Lyons Arthi Senthilkumar	$2,027	1 Oct 2019	30 Sep 2021
Ministry of Health Oral Health Research Fund	The affordability of dental care in New Zealand	Jonathan Broadbent William Leung (Public Health, UOW) Trudy Sullivan (Preventive & Social Medicine, OMS)	$53,556	1 Oct 2019	31 Dec 2021
Ministry of Health Oral Health Research Fund	Oral health status and Oral-Health-Related Quality of Life of a group of young adults using mental health services in Christchurch	Murray Thomson Emma Johnson Graeme Ting Juliet Gray (Canterbury DHB)	$2,923	1 Oct 2019	30 Sep 2021
Ministry of Health Oral Health Research Fund	An exploratory study of the education needs of practising lead maternity carer (LMC) midwives: enablers and barriers to providing evidence based oral health advice and oral health promotion to their clients during pregnancy	Graeme Ting Ceridwen Benn Billie Bradford (VUW)	$4,580	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	Community based oral health promotion among adult Syrian former refugees resettled in Dunedin, New Zealand	Jonathan Broadbent Warwick Duncan Moira Smith (Public Health, UOW) Zeina Al Naasan	$15,000	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	Evaluation of Electrolysed Oxidising Water (EOW) as a multipurpose, non-toxic and cost-effective disinfectant in dental healthcare	Richard Cannon Karl Lyons Geoffrey Tompkins Chitra Krishnan	$14,805	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	Development and characterization of a novel hydroxyapatite-silicate cement for use in dental pulp capping	Peter Cathro Jithendra Ratnayake David Yong	$12,335	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	Biomimetic remineralization: A comparative evaluation of novel peptide-based agents for enamel regeneration	Manikandan Ekambaram Kai Chun Li Suneil Nath	$15,000	1 Oct 2019	30 Nov 2021

Funding body	Prtoject title	Named investigators	Awarded	Start	End
New Zealand Dental Research Foundation	Modulation of osteoblasts and periodontal ligament cells by IL-17 and IL-6	Fiona Firth Marguerite Paterson Mauro Farella Trudy Milne	$15,000	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	Surface modification of orthodontic elastomers to overcome biofilm formation	Peter (Li) Mei Richard Cannon Michael Skilbeck	$13,478	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	New Zealand's School Dental Service 1921-2021*	Susan Moffat	$5,475	1 Oct 2019	5 May 2020
New Zealand Dental Research Foundation	Investigating biomarkers in exosomes derived from serum and saliva of patients with oral squamous cell carcinoma	Alison Rich Mohammad Aziz Merilyn Hibma (Pathology, OMS) Haizal Hussaini Benedict Seo	$15,000	1 Oct 2019	30 Sep 2020
New Zealand Dental Research Foundation	The effect of mechanical decontamination procedures on moderately roughened titanium surfaces: quantity and size of the titanium particulate released by mechanical intrumentation	Andrew Tawse-Smith Warwick Duncan Anthony Yu-Chieh Kao Sunyoung Ma	$14,455	1 Oct 2019	30 Sep 2021
New Zealand Dental Research Foundation	Wear of glazed vs. non-glazed translucent monolithic zirconia against bovine enamel	Neil Waddell Joanne Choi Kai Chun Li Karl Lyons Abdelrahman Badarneh	$6,664	1 Oct 2019	30 Sep 2020
Fuller Scholarships in Dentistry	Can aligners move roots? Let's torque about it	Mauro Farella Julia Smith	$4,782	1 Nov 2019	31 Oct 2021
Fuller Scholarships in Dentistry	What's in a smile? An investigation of the effect of ethnic background on smiling features	Mauro Farella Reginald Kumar	$5,000	1 Nov 2019	31 Oct 2021
Fuller Scholarships in Dentistry	Perceived confidence in performing peripheral venipuncture among dental practitioners in New Zealand and Malaysia	Graeme Ting Darryl Tong Mohd Hakimin Mohamed Ashri	$3,000	1 Nov 2019	31 Oct 2021
Sun Pharma Global FZE	*In vitro* inhibition in oral lichen planus	Alison Rich Haizal Hussaini Benedict Seo Qing Sun	$192,138	1 Nov 2019	31 Oct 2021
Fuller Scholarships in Dentistry	*In vitro* corrosion and wear resistance of glazes for monolithic zirconia crowns	Neil Waddell Kai Chun Li Raj Gaurav Singh	$4,900	1 Jan 2020	31 Dec 2021
In Vitro Technologies	InVitro Annual donation	Michael Morgan	$150,000	1 Jan 2020	31 Dec 2023
Maurice and Phyllis Paykel Trust	Real-time measurement of the denture-mucosa pressure distribution in edentulous patients	Joanne Choi Sunyoung Ma Jaspreet Dhupia (University of Auckland) Neil Waddell Peter Xu (University of Auckland)	$10,000	1 Jan 2020	31 Dec 2020
New Zealand Lottery Grants Board	A 3D bioprinter for tissue engineering research in Dentistry	Dawn Coates Karl Lyons Alison Rich William Early (Otago Polytech) Mauro Farella	$52,500	1 Jan 2020	31 Dec 2021
MedTech CoRE (University of Auckland subcontract)	MedTech CoRE - Needle free injections	Paul Brunton Carolina Loch Santos da Silva	$41,376	1 Jan 2020	30 Jun 2021
University of Otago Research Grant	Regeneration of dental pulp tissue using a novel hybrid biomaterial	Azam Ali (Food Science) Lara Friedlander Karl Lyons	$43,930	1 Jan 2020	31 Dec 2020

Funding body	Prtoject title	Named investigators	Awarded	Start	End
University of Otago Research Grant	Positive self-esteem via aesthetic identity management through access to orthodontic services, for juveniles and their parents/ guardians	Lisa McNeill (Marketing) Peter (Li) Mei	$9,714	1 Jan 2020	31 Dec 2021
University of Otago Research Grant	Cattle bone in Root Canal therapy? Development of a novel root canal medicament from New Zealand-sourced waste bovine bone	Jithendra Ratnayake Peter Cathro Joanne Choi George Subasinghe Dias (Anatomy)	$36,486	1 Jan 2020	30 Jun 2021
University of Otago Research Grant	Oral health inequity among patients diagnosed with cancer: exploring the impacts on quality-of-life and survivorship	Moira Smith (Public Health (UOW)) Cheryl Davies (Public Health, UOW) Catherine Ferguson (Public Health, UOW) Virginia Signal (Public Health, UOW) Moira Smith (Public Health, UOW) Ramona Tiatia (Public Health, UOW) Graeme Ting	$38,506	1 Jan 2020	30 Nov 2020
Otago Innovation Limited	Initial formulation of manuka oil for delivery on collagen sheet devices	Warwick Duncan Gemma Cotton	$44,000	1 Feb 2020	31 Dec 2020
BLIS Technologies Limited	Genome analysis of bacterial strains	Nicholas Heng	$14,000	1 Apr 2020	30 Jun 2020
Colgate Palmolive Limited (NZ)	What's in a smile? Impact of oral health on smiling features	Mauro Farella Hamza Bennani (Computer Science)	$40,000	1 Apr 2020	31 Mar 2022
Ministry of Education Malaysia (Higher Education)	PhD Research Grant - N A Ngah	Haizal Hussaini	$10,000	1 May 2020	30 Apr 2021
Cure Kids	Development of white crowns to treat dental caries in children - Phase 2	Joanne Choi	$14,215	1 Jun 2020	10 Jun 2021
Cure Kids	Parent resource for supporting a young person who is engaging in self-harm	Sarah Fortune (Psychological Medicine, OMS) Kai Chun Li	$130,287	1 Jun 2020	27 Oct 2020
New Zealand Lottery Grants Board	Ultrasound cancer screening device and contrast agent project	Warwick Duncan Tanmoy Bhattacharjee	$119,749	1 Jun 2020	31 May 2022
Health Research Council of NZ (HRC)	Interrogating immunotherapy for dental pulp therapy and management	Haizal Hussaini Lara Friedlander Chuen Yen Hong Benedict Seo Qing Sun	$206,046	1 Aug 2020	31 Jul 2023
International College of Prosthodontists	An in-vitro study of accuracy of partial denture frameworks fabricated by conventional and digital workflow	Sunyoung Ma Majd Khashashneh	$7,692	1 Aug 2020	31 Dec 2021
BLIS Technologies Limited	Validation of qPCR and training	Trudy Milne	$4,500	1 Sep 2020	31 Oct 2020
New Zealand Research Foundation of the ANZHNCS	Exosomal biomarkers in blood plasma and saliva of oral cancer patients	Benedict Seo Merilyn Hibma (Pathology, OMS) Haizal Hussaini Alison Rich	$15,000	1 Sep 2020	31 Aug 2021
Foundation for Orthodontic Research & Education, NZAO Charitable Trust	FORENZAO DClinDent student award	Mauro Farella	$3,863	1 Oct 2020	30 Sep 2022
Fuller Scholarships in Dentistry	Three-dimensional stereophotogrammetry analysis of lip response to changes of incisor position and occlusal vertical dimension,	Peter (Li) Mei Vincent Bennani Mauro Farella	$5,000	1 Oct 2020	30 Sep 2021

Funding body	Prtoject title	Named investigators	Awarded	Start	End
Fuller Scholarships in Dentistry	Analysis of changes in saliva composition in patients with oral cancer and oropharyngeal cancer using Fourier Transform Infrared Spectroscopy	Graeme Ting Sunethra Tennekoon	$5,000	1 Oct 2020	30 Sep 2022
Fuller Scholarships in Dentistry	A novel application of knotless sutures in third molar surgery	Darryl Tong Harsha De Silva Rohana De Silva Murray Thomson Nigel Tan	$5,000	1 Oct 2020	30 Sep 2022
Ministry of Health Oral Health Research Fund	Towards understanding inequality in oral health-related quality of life	Jonathan Broadbent Chuen Lin Hong Murray Thomson	$39,152	1 Oct 2020	30 Sep 2022
Ministry of Health Oral Health Research Fund	Oral health care experiences of patients undergoing treatment for head and neck cancer	Murray Thomson Tania Stuart Jonathan Broadbent Lee Adam	$8,250	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Evaluation of mechanical properties, wear behaviour and polishability for occlusal splints by various manufacturing methods	Joanne Choi Sunyoung Ma Neil Waddell Ana Grymak	$10,860	1 Oct 2020	30 Sep 2021
New Zealand Dental Research Foundation	Does the intra-operative use of advanced platelet-rich fibrin (A-PRF) improve post-operative outcomes in third molar surgery?	Harsha De Silva Rohana De Silva Murray Thomson Darryl Tong	$7,350	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Development and optimisation using supercritical fluid CO_2 extraction of bovine bone for oral block grafting	Warwick Duncan Kai Chun Dawn Coates Neil Waddell	$15,000	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Effect of passive clear aligners on masticatory muscle activity in adults with and without oral parafunction	Mauro Farella Nick Pittar Fiona Firth	$10,000	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Patients' experiences with orthodontic treatment through traditional fixed appliances, clear aligners and direct-to-consumer clear aligners: a qualitative study	Fiona Firth Sherry Lee Mauro Farella Peter (Li) Mei Ben Daniel (Higher Education Development Centre)	$10,000	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Can immunotherapy be used in inflamed dental pulp tissue to preserve tooth vitality?	Haizal Hussaini Shelly Arora Paul Cooper Lara Friedlander Alison Rich Shakila Rizwan (Pharmacy) Benedict Seo	$15,000	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Osteoinductive potential of bioactive glass, collagen and lyophilized platelet-rich fibrin scaffold for alveolar cleft osteoplasty	Haizal Hussaini Aida Ngah George Subasinghe Dias (Anatomy) Darryl Tong Jithendra Ratnayake	$14,980	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	An *in vitro* study of accuracy of partial denture frameworks fabricated using traditional and digital workflows	Sunyoung Ma Joanne Choi Sergio Salis	$14,900	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Three-dimensional stereophotogrammetry analysis of lip response to changes of incisor position and occlusal vertical dimension	Peter (Li) Mei Vincent Bennani Mauro Farella Khac Thuong Nguyen	$1,500	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	The development of a novel dual-action antimicrobial peptide to prevent root caries	May (Lei) Mei Richard Cannon Manikandan Ekambaram Peter (Li) Mei Chun Hung Chu (Hong Kong University)	$15,000	1 Oct 2020	30 Sep 2022

Funding body	Prtoject title	Named investigators	Awarded	Start	End
New Zealand Dental Research Foundation	MiniG*1600 – Automated Tissue Bead Mill Homogeniser and Cell Lyser	Trudy Milne Erwin Lamping Richard Cannon	$15,000	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Bringing waste cow bone to toothpaste: Development and testing of a novel silver-substituted bovine derived nanohydroxyapatite toothpaste for caries management	Jithendra Ratnayake May (Lei) Mei Paul Cooper Geoffrey Tompkins	$8,919	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Gold nanoparticles : A novel treatment strategy for oral mucositis	Don Schwass Paul Brunton Carla Meledandri (Chemistry) Geoffrey Tompkins	$10,330	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Use and utility of teledentistry in aged residential care facilities in the Otago region of New Zealand	Graeme Ting Beatrice Ng Ari Samaranayaka (Biostatistics Centre) Moira Smith (Public Health, UOW)	$5,000	1 Oct 2020	30 Sep 2022
New Zealand Dental Research Foundation	Measuring dry mouth in older people in care in Dunedin	Graeme Ting Murray Thomson Farah Zainuddin	$4,367	1 Oct 2020	30 Sep 2022
Foundation Trust University of Otago	SJWRI Sidey Trust Award	Angela Clark	$12,000	1 Nov 2020	31 Oct 2022
3M (NZ)	The effect of incisal preparation design on cement thickness and distribution of porcelain laminate veneers	Vincent Bennani John Aarts Belinda Liu	$2,087	1 Dec 2020	30 Nov 2021
Ministry of Health Oral Health Research Fund	Promoting and protecting the oral health of dependent older New Zealanders 'ageing in place'	Moira Smith (Public Health, UOW) Catherine Ferguson (Public Health, UOW) Graeme Ting	$44,000	1 Jan 2021	31 Dec 2021
University of Otago Research Grant	Aerosol generation level by different dental high-speed handpieces	Joanne Choi Jane Choi Susan Moffat Neil Waddell	$29,488	1 Jan 2021	31 Dec 2021
University of Otago Research Grant	Development of a novel bioactive ovine-teeth derived dental putty for clinical applications	Jithendra Ratnayake Samuel Carrington Paul Cooper George Subasinghe Dias (Anatomy)	$30,307	1 Jan 2021	31 Dec 2021
New Zealand Lottery Grants Board	Zygo ZeGage Pro 3D Optical Surface Profiler	Fiona Firth Mauro Farella Peter (Li) Mei	$124,121	1 Mar 2021	28 Feb 2022

*Grant declined by PI post-award.

Doctoral research completions and thesis abstracts

Doctor of Philosophy (PhD) completions, 2019-2020

Student	Advisors (Primary listed first)	Thesis title	Graduated
Syarida Safii	Prof Warwick Duncan Assoc Prof Geoffrey Tompkins Assoc Prof Dawn Coates Assoc Prof Natalie Medlicott	Manuka-derived products as an adjunct to scaling and root planing in the treatment of chronic periodontitis	May 2019
Benedict Seo	Prof Alison Rich Assoc Prof Dawn Coates Prof Gregory Seymour	Endoplasmic reticulum stress and unfolded protein responses in oral squamous cell carcinoma	May 2019
Sunyoung Ma	Prof Alison Rich Prof Warwick Duncan	Endoplasmic reticulum stress and unfolded protein responses in oral squamous cell carcinoma	Dec 2019
Amira Salem	Assoc Prof Geoffrey Tompkins Mr Peter Cathro	Novel therapeutic targets for endodontic infections	Dec 2019
Zhen Dong	Assoc Prof Dawn Coates Dr Trudy Milne Prof Alison Rich Dr Stephen Haines	Protein discovery platform using deer antler as a model of mammalian regeneration	Dec 2020
Golnoush Madani	Prof Richard Cannon Dr Erwin Lamping Assoc Prof Alok Mitra	Biochemical and structural analysis of *Candida albicans* multidrug efflux pump Cdr1	Dec 2020
Sabarinath Vadakkedath Prasad	Prof Mauro Farella Assoc Prof Michael Paulin Prof Richard Cannon	Wearable devices for jaw activity monitoring	Dec 2020
Shaikhah Alsamahi	Assoc Prof Lara Friedlander Assoc Prof Haizal Mohd Hussaini Prof Alison Rich Dr Trudy Milne	Type 2 diabetes and the dental pulp	May 2021

PhD thesis abstracts

Shaikhah Alsamahi

Alsamahi, S. A. S. M. (2020). Type 2 diabetes and the dental pulp.
http://hdl.handle.net/10523/10588

Type 2 diabetes (T2D) is an international health burden. Globally, it is the most common chronic disease and its incidence is increasing. Type 2 diabetes mellitus is a metabolic proinflammatory disorder characterised by chronic hyperglycaemia resulting in an altered immune response and delayed healing. Patients with T2D are common in general dental practice. Oral complications of T2D are well recognised, particularly associated with periodontal disease but the influence of hyperglycaemia on the dental pulp is unclear.

Inflammation and immune responses of the dental pulp are similar to those in other connective tissue in the body and are mediated by several cellular and molecular factors to minimise harmful effects induced by the irritating factors. Hyperglycaemia affects body tissues through a non-enzymatic process known as glycation and the accumulation of irreversible advanced glycation end products (AGEs). AGEs accumulation is responsible for diabetic complications such as thickened connective tissue and increased tissue inflammation. AGEs exert noxious effects on tissues through an advanced glycation end-product receptor (RAGE).

Normal tissue and a regulated inflammatory response contribute to healing. The histological, immunological and inflammatory changes in human clinically normal dental pulp in T2D patients are limited. Improved knowledge and understanding of these changes may assist clinicians in planning care to manage patients with T2D diagnosed with pulp disease.

Hypothesis & Objectives: The hypothesis of this thesis is that T2D affects the clinically normal dental pulp by altering histological, immunological, and inflammatory responses. To test this hypothesis, the current study has three main objectives. The first is to evaluate the histological, immunological and inflammatory changes in the clinically normal dental pulp of patients with T2D. The second objective is to evaluate the glycation process in the dental pulp by evaluating AGEs and their receptors RAGE, Galectin-3 (Gal-3), and the related inflammatory response. The third is to establish an *in vitro* diabetic model and evaluate the effect of high glucose concentration on human dental pulp cell (hDPCs) behaviour and gene expression.

Methods: Ethical approval for this study was gained from the University of Otago Human Ethics Committee (Health) (Project Reference H16/069 and Project Reference H18/077) and Māori consultation was entered with the Ngāi Tahu Research Committee. Clinically normal (healthy) and extracted permanent teeth were collected from T2D (n=20) and non-diabetic (n=20) participants for the first and second objectives.

To achieve the first and second objectives, histological staining, immunohistochemistry (IHC), immunofluorescence (IF), double immunofluorescence (DIF) and quantitative polymerase chain reaction (qPCR) were used. Following extraction, teeth from T2D (n=10) and non-diabetic (n=10) participants were cut transversely below the cementoenamel junction (CEJ), formalin fixed, decalcified in 10% ethylenediaminetetraacetic acid (EDTA), and paraffin embedded. Sections were stained with haematoxylin and eosin (H&E), Massons trichrome, Van Gieson (VG) and silver reticulin stains for histological evaluation. Other sections were used for IHC using anti-TLR2, anti-TLR4, anti- CD4, anti-CD68, anti-CD83, anti-FOXP3, anti-interleukin (IL)1!, anti-IL6, anti-tumour necrosis factor (TNF)-", anti- AGEs, and anti-RAGE. Three sections were used for IF using anti-AGEs and other five sections were used for DIF using anti-RAGE with anti-CD4 and anti-vimentin.

Remaining teeth from T2D (n=10) and non-diabetic (n=14) participants were used for gene expression analyses. Immediately after extraction teeth were sectioned transversely below the CEJ, and the coronal pulp was removed for ribonucleic acid (RNA) extraction. Messenger RNA (mRNA) levels for AGE, RAGE, S100A12 and NF-#B were determined using TaqMan assays.

For the cell culture experiments, coronal pulp tissue was excavated from mature unerupted third molar teeth extracted from healthy adults (n=4) and cell lines generated using the explant method. An *in vitro* diabetic model by using different glucose concentrations mimicking blood glucose concentrations was used to evaluate the effect of normal and high glucose on viability and gene expression of hDPCs at 1, 3 and 5-day time-points.

Data Analysis: Histological slides and IHC samples were scanned by an Aperio Scanscope CS2 image capture device, analysed under light microscopy and digitised with ImageScope. Data analysis was performed qualitatively and semi-quantitatively (number of positive cells/image area) to assess the histological changes and the protein expression in the specimens.

The DIF sections for RAGE, vimentin and CD4 were viewed and images were taken using an EVOS M5000 inverted fluorescent microscope. The slides were examined, and the individual and merged proteins in non-T2D and T2D dental pulp were qualitatively identified. The staining was examined, and proteins were qualitatively identified, and merged in non-T2D and T2D dental pulp.

The mRNA expression analysis was performed using comparative quantification cycle (Cq) values. The fold difference (FD) for each gene was calculated between the two groups. Data analyses were performed with GraphPad Prism®, using Student's t-tests at P-value <0.05.

The viability data analysis in cell culture was performed using GraphPad Prism and Excel software for Mac OS Catalina (Version 10.15.4). The data are presented as mean and standard deviation (SD). A Student's t-test was used and the differences between the groups were considered significant when P-value <0.05.

The gene expression in cell culture was performed by using the comparative Cq method to calculate the difference in the mRNA expression between the 5.5mM and 25mM D-glucose concentrations at the different time-points.

Results: Histological changes were observed in normal dental pulp of participants with T2D compared to healthy controls. T2D resulted in a dental pulp that was less cellular, less vascular, evidence of thickened blood vessel walls, increased pulp calcification, increased collagen and decreased elastin deposition. The positive cell count/area showed increased expression of CD68 (P<0.001), CD83 (P=0.04), and decreased expression of FOXP3 (P=0.01) in T2D dental pulp compared with non-T2D samples. The positive cell count/area analysis also showed that the cytokines were significantly increased in T2D (IL1! (P=0.01), IL6 (P<0.0001), IL17 (P<0.0001) and TNF-" (P=0.01)). The glycation process was significantly increased in the dental pulp of T2D as evidenced by increased IHC expression of AGE (P<0.0001) and RAGE (P=0.02). The qPCR results showed that the expression of RAGE, S100A12, NF-#B and COL1A1 mRNA genes was significantly increased in the dental pulp of T2D compared with the non-T2D samples (P<0.0001), while no significant changes were detected for Gal-3 mRNA expression. The glycation process was also assessed by IF and DIF which showed increased accumulation of AGE in the extracellular matrix (ECM) and around blood vessel walls. DIF showed co-localisation of RAGE and vimentin and co-localisation of RAGE and CD4, indicating RAGE was expressed on fibroblasts and CD4+ve cells.

The results of the study using an *in vitro* diabetic cell culture model showed that high glucose concentration was associated with a reduced viability rate of hDPCs with increasing time. Furthermore, the used highest glucose concentration resulted in increased expression of collagen type III (COL3A1) and increased mineralisation due to the increased expression of ALP over time. The cell culture mRNA showed that high glucose resulted in increased gene expression of RAGE and decreased expression of Gal-3.

Conclusions: T2D leads to changes in dental pulp morphology, altered immunosurveillance and increased cytokine expression in the dental pulp. The glycation process was clearly evident in the pulp from T2D patients and may be responsible for the changes observed. These changes in clinically normal dental pulp in T2D patients may influence the healing response following pulpal injury and may affect the treatment plan and treatment outcome for these patients.

Zhen Dong

Dong, Z. (2020). Protein discovery platform using deer antler as a model of mammalian regeneration.

http://hdl.handle.net/10523/10435

The ability to activate and regulate stem cells during wound healing and tissue regeneration is a promising

field which could bring innovative approaches into regenerative medicine. The regenerative capacity of invertebrates has been well documented, however in mammals, stem cells that drive organ regeneration are rare. Deer antler is the only known mammalian structure that can annually regenerate to produce a complex tissue. The neural crest derived stem cells that drive this process result in antler growing at up to 2 cm/day. Deer antler appears to outweigh lower-order animal models when investigating the regulation of stem cell-based regeneration. Pleiotrophin (PTN) is a multifunctional heparin-binding growth factor; the PTN gene is found highly expressed within the active antler stem cell tissues. The studies presented in this thesis aimed to examine the location of stem cells during antler growth, the proteomic profiles of different pools of stem cells involved in antler generation and regeneration, and the role of the PTN growth factor family in stem cell regulation.

The differentially expressed proteins between cells derived from stem cell niches involved in antlerogenesis (antlerogenic periosteum) and regeneration (potentiated and dormant pedicle periosteum), and cells derived from deer facial periosteum as a control (n = 3) were identified using 2D-DIGE-based quantitative proteomics. Label-free mass spectrometry was further used to detect the protein expression profiles of antler stem cell tissues under different stages of activation and included: dormant pedicle periosteum, growth centre, post-active stem cells from mid-beam periosteum, and control facial periosteum (n = 3). Mesenchymal stem cell markers CD73, CD90 and CD105, along with PTN/midkine (MDK) growth factors and their receptors (PTPRZ, ALK, NOTCH2, ITGAV and ITGB3), were examined in antler tissues using immunohistochemistry. *In vitro* effects of PTN on proliferation and osteogenic differentiation of antler stem cells were also investigated.

Ninety-two differentially expressed proteins were identified by 2D-DIGE. Bioinformatic analysis indicated the epithelial-mesenchymal transition process may participate in the initiation of wound healing and subsequent antler regeneration; cell mobility was highly involved during antler regeneration; energy and nucleotide metabolism may however be less active in antler regeneration as compared to that in antler generation phase. Immunohistochemistry confirmed the central role of stem cells in the development of this mammalian structure by localising the mesenchymal stem cell markers within the antler growth centre. Label-free quantification distinguished unique markers of dormant (6), active (87) and post-active (3) antler stem cells showing that the greatest number of proteins was exclusively found in the active stem cell tissue. There were only 12 proteins detected with expression levels that significantly differed between tissue with dormant stem cells and the control tissues. Protein profiles of these two groups showed that antler stem cells may use similar mechanisms to maintain dormancy within a stem cell niche. One hundred fifty-three significantly regulated proteins were found between antler stem cell tissues under different activation stages; activation of antler stem cells was associated with up-regulation of a number of canonical pathways and molecular/cellular functions such as Hippo and canonical Wnt signalling. PTN was identified as the dominant growth factor in the PTN/MDK family with higher expression levels in the antler growth centre. High expression of PTPRZ and ALK co-localised with PTN suggested their potential interactions. The high levels of PTN and PTPRZ also reflected the antler stem cell activation status during the regenerative process. When antler stem cells were cultured *in vitro* under the normoxic condition, no PTN was expressed and exogenous PTN did not induce differentiation or proliferation but rather stem cell maintenance.

In summary, this research project explores potential biomarkers for mammalian stem cells, as well as the key proteins, biological processes and pathways involved in stem cell maintenance, development and activation during antler generation and regeneration.

Sunyoung Ma

Ma, S. (2019). Immediately placed single implants in the maxillary anterior zone: 5-year clinical study.

http://hdl.handle.net/10523/9658

Single implant crowns have become a popular treatment modality to replace a missing natural tooth. They have an excellent long-term success rate, especially when supported with a conventional placement and loading protocol. However, with increasing demand of patients wanting a reduced turnaround time with an aesthetically pleasing outcome, there has been a push for shorter healing and rehabilitation period so that the patients can return to function quicker.

Immediate implant placement and restoration may be able to address this demand especially when the treatment involves the maxillary anterior zone. However, the anatomical morphology of a fresh extraction socket is often unfavourable especially when planning for a screw-retained implant prosthesis. A novel design of a 12°-platform implant has the advantage of achieving the necessary primary stability, especially when it is placed in a fresh extraction socket, the reconfigured platform angle allows the screw access to be oriented appropriately. However, there are only two clinical studies about this technique and they report up to 1-year follow-up data. Hence there is a demand for information about more long-term clinical outcomes.

Zirconia implant abutments have also become very popular particularly for those clinicians and patients who would like to pursue "metal-free" dentistry. While zirconia has proven to be a strong material suitable for implant prostheses, there is a significant lack of clinical data on the effect of low-temperature degradation especially in relation to any post-sintering adjustment. Therefore, it is the aim of this project addresses this research question.

Golnoush Madani

Madani, G. (2020). Biochemical and structural analysis of *Candida albicans* multidrug efflux pump Cdr1.

http://hdl.handle.net/10523/10257

Pleiotropic drug resistance (PDR) ATP-binding cassette (ABC) transporters are abundant eukaryotic membrane proteins that pump a vast array of different compounds across organelle and cell membranes. Overexpression of the archetype fungal PDR transporter Cdr1 is the main cause of azole drug resistance in *Candida albicans*, a major fungal pathogen that can cause serious, life threatening, invasive fungal infections in immunocompromised individuals. Fluconazole, an azole antifungal, is commonly used to treat these infections. Azole resistance of *C. albicans* isolates, however, is of serious clinical concern with often fatal outcomes. An attractive approach to overcome azole resistance is the use of efflux pump inhibitors in combination with azoles. In order to achieve this result, understanding how these efflux pumps work and obtaining high-resolution structures will help to develop suitable inhibitors that do not easily give rise to resistance. Yet, to date, no structure for any PDR ABC transporter has been solved. PDR transporters are one of the largest membrane protein superfamilies. Many plants and fungi have more than ten, some up to 50, different PDR transporters; which indicates that they are likely to be important for their survival in complex, frequently changing, environments. As such, they are of great importance to human fungal disease, and in agriculture.

The objectives of this project were to: i) investigate the role of cysteine amino acids in the stability, trafficking and function of *C. albicans* Cdr1; ii) hyperexpress Cdr1 in the eukaryotic model organism, Saccharomyces cerevisiae, and optimise the isolation and purification of Cdr1; and iii) attempt to determine the structure of Cdr1 with X-ray crystallography or cryo-EM.

In this PhD project, a successful workflow was developed that led to the purification of 0.5 mg Cdr1 per litre of the culture medium in pure, stable, monodisperse form that was used to perform structural investigations of Cdr1 with X-ray crystallography and cryo-EM. In addition, 21 cysteine-deficient Cdr1 mutants were created, and biochemically characterised, which revealed that the six conserved extracellular cysteines were most critical for proper Cdr1 expression, localisation, and function. One fully functional 'almost Cys-less' version of Cdr1, Cdr1P-CID, with all but the six conserved extracellular cysteines replaced with serine, alanine or isoleucine was constructed. Cdr1P-CID will be critical in cysteine-crosslinking studies that will help confirm the biological significance of any future structure of Cdr1. An additional four mutants were constructed to generate catalytically inactive transporters. Two conserved nucleotide binding domain residues (D327 and E1027) contributing catalytic bases for ATP-hydrolysis, were replaced with asparagine or glutamine. In addition to those three mutants (Cdr1-D327N, -E1027Q, and -D327N-E1027Q), a fourth catalytically inactive Cdr1 mutant (Cdr1-K901A) was also generated.

Detergent screening, using 31 detergents with different chemistries, revealed that n-dodecyl-β-D-maltopyranoside (DDM) and lauryl maltose neopentyl glycol (LMNG) worked best for Cdr1 solubilisation and/or purification. They provided purified monomeric Cdr1 molecules for crystallography and electron microscopy. Crystal trials using four different commercial crystal screens identified some conditions that resulted in small crystal formations that need to be optimised in order to grow bigger crystals. Protocols for negative stain EM and cryo-EM were optimised which resulted in the first very low-resolution (~18 Å) structures of negative stained detergent-purified Cdr1, however more work is needed to resolve ambiguities between the structures. This study has revealed important insights into the structure-function relationship of *C. albicans* Cdr1 and laid the foundations for obtaining high-resolution Cdr1 structures.

Syarida Safii

Safii, S. H. (2018). Manuka-derived products as an adjunct to scaling and root planing in the treatment of chronic periodontitis.

http://hdl.handle.net/10523/8513

Antibiotics and antiseptics are used as locally-delivered antimicrobial adjuncts in conjunction with scaling and root planing (SRP), mostly to treat non-responding and recurrent deep periodontal pockets. Adjunctive therapy is deemed necessary to support and optimise periodontal healing by eliminating or suppressing gram-negative bacteria associated with periodontal diseases. However, due to developing antibiotic resistance, alternative antimicrobials originating from plants have been considered. Bioactive substances from this source have potent antibacterial properties and wound healing potential. The research described in this thesis investigated the potential of manuka-derived products (manuka honey and manuka oil) as antimicrobials to be administered to periodontal pockets as an adjunct to SRP.

In vitro and *in vivo* investigations were performed to answer the research questions related to this topic. Antibacterial activities of manuka-derived products were assessed. Clinical and microbiological outcomes following SRP and application of manuka honey were measured. Toxicology profile of manuka oil was determined using cell culture methods. A delivery device for the administration of manuka oil to periodontal pockets was developed. This device was assessed for antibacterial activity and penetration into a single-species biofilm.

Manuka honey exhibited broad-spectrum antimicrobial activity against a variety of plaque-associated bacteria. The present *in vitro* investigation demonstrated that decreasing the concentration of honey not only reduced the antimicrobial activity but also promoted bacterial carbohydrate metabolism and consequent acid production by Streptococococcus mutans, further exacerbating demineralisation. Furthermore, manuka honey is slow-acting, thus limiting its efficacy in periodontal pockets due to significant dilution. The split-mouth clinical study of a three-month follow-up did not show additional improvement in clinical parameters when periodontal pockets were treated

with manuka honey following SRP compared to SRP alone. In contrast, manuka oil showed encouraging potential as a therapeutic substance. When comparing the two manuka-derived products, manuka oil (effective concentration = 0.1% w/v) was more potent than manuka honey (effective concentrations ranged = 13-25% w/v).

Manuka oil also showed a relatively rapid bactericidal effect. The toxicology profile of manuka oil based on half maximal inhibitory concentrations (IC50) determined at 96 hours was four times higher than the effective antimicrobial concentration, whereas the IC50 of chlorhexidine was 100 times higher than its therapeutic concentration. This investigation suggests that apoptosis rather than necrosis may be the mechanism of cell death induced by manuka oil under cell culture conditions. The compositions of a delivery device demonstrated favourable rheological properties, that is, pseudoplastic or shear thinning behaviour and increased elasticity with increasing frequencies which may improve retention in periodontal pockets. The emulsion containing manuka oil under experimental conditions was more effective than chlorhexidine at reducing the proportions of bacteria in the biofilms, as indicated by the increased of red fluorescence (live/dead staining) viewed in the confocal scanning laser microscope images. In addition, the emulsion containing manuka oil was consistently active through the entire depth of the biofilm compared to chlorhexidine.

The major implication of this research project is to support the potential uses of bioactive substances derived from plants as antimicrobials in periodontal therapy. Manuka oil may be superior to manuka honey as an antimicrobial for intra-oral applications.

Amira Salem

Salem, A. S. A. I. (2019). Novel therapeutic targets for endodontic infections.

http://hdl.handle.net/10523/9663

Dental root canal treatment was first attempted in 1728 (Hasegawa 1983), and is routinely performed all over the world, despite a significant failure rate. The primary cause of failure is bacterial infection, and the most commonly associated bacterium from secondary root canal infections is *Enterococcus faecalis* with isolation rate ranging from 30 to 70 %. *E. faecalis* produces biofilms and tolerates the high alkalinity of calcium hydroxide; the most commonly used intracanal medication. When conditions inside the root canal become extreme (low nutrients and high pH), *E. faecalis* is selected leading to inflammation of the periapical tissues and consequently treatment failure. One proposed mechanism for the adaptation of *E. faecalis* to high pH is the involvement of two membrane proteins that are upregulated under conditions of nutrient deprivation and elevated alkalinity; specifically glycosyl hydrolase (Ef0114) and glycerol facilitator membrane protein (GlpF) (Ef1927).

The overall aim of this study was to assess the involvement of glycosyl hydrolase and GlpF in alkaline tolerance and biofilm formation by *E. faecalis.* The specific aims were:

(i) to compare alkaline tolerance among root canals isolates of *E. faecalis* and non-root canal isolates in order to determine if the conditions within the treated root canal select strains better able to adapt and survive.

(ii) To investigate the involvement of the glycosyl hydrolase and GlpF in alkaline tolerance and biofilm formation. The up-regulation of these membrane proteins could be related to a generalized stress response rather than a specific reaction to the alkaline condition, and targeting these proteins could offer alternative treatment strategies.

The study revealed considerable variability in alkaline tolerance among strains of *E. faecalis*, and the root canal isolates were no more tolerant than non-root canal strains. GlpF is a highly conserved membrane protein with minimal variation among *E. faecalis* strains. Whereas, the glycosyl hydrolase showed amino acid variations but with no correlation to alkaline tolerance.

Biofilm formation was variable among strains of E. faecalis; however it was highly influenced by the type of carbohydrate available and the pH. Thicker biofilms were formed in the presence of glucose compared to glycerol, and at pH 8 compared to pH 11. In addition, the metabolic activity of the biofilm bacteria was significantly higher when the biofilm was originally formed in glycerol compared to glucose. Blocking of the glycosyl hydrolase with PUGNAc (analogue of N-acetyl glucosamine) significantly decreased the biofilm biomass formed in glucose and the metabolic activity of biofilm formed in glycerol.

Glycerol metabolism contributed to the alkaline tolerance of *E. faecalis* by accelerating the growth of the least tolerant strain at pH 11, and by increasing the metabolic activity of the biofilm bacteria subjected to high pH.

Genetic modification of *E. faecalis* was challenging. Various approaches were therefore attempted to derive mutants of the two genes of interest including deletion mutation and transposon mutagenesis. Ef0114 (encoding glycosyl hydrolase) was successfully deleted, while potential mutants of Ef1927 (encoding GlpF) reverted to the wild type, strongly suggesting that GlpF is essential for survival of *E. faecalis*.

Screening of a library of 5000 transposon derivatives did not result in any alkaline-sensitive mutants. However, two transposon mutants of each of the targeted genes were identified in a previously sequenced transposon library providing opportunity for investigating their involvement in alkaline tolerance and biofilm formation.

Both the glycosyl hydrolase deletion mutant and the GlpF transposon mutants showed minimal difference in tolerance from the wild-type strain. On the other hand, a GlpF over expressing strain exhibited accelerated growth at pH 11 compared to the wild-type, and GlpF downregulation in a ΔErs (*Enterococcus* regulator of survival) mutant decreased the metabolic activity of the biofilm, suggesting a contribution to alkaline tolerance.

Application of glycosyl hydrolase inhibitor (PUGNAc) led to the conclusion that the contribution of glycosyl hydrolase to alkaline tolerance is in part due to metabolism of complex glycoproteins that provide energy and results in acidification of the alkaline environment.

However, this effect is likely a contributor rather than the principal mechanism of surviving high pH.

Of note, Auphen (gold III compound), a recognised inhibitor of mammalian GlpF, demonstrated an effective antimicrobial action against *E. faecalis*, providing encouraging evidence that GlpF constitutes an accessible target for effective antimicrobial treatment.

Benedict Seo

Seo, B. (2019). Endoplasmic reticulum stress and unfolded protein response in oral squamous cell carcinoma.

http://hdl.handle.net/10523/9063

Oral squamous cell carcinoma (OSCC) is the most frequent form of cancer of the head and neck region, with high rates of morbidity and mortality. It significantly impacts the individual patients affected, as well as society at large, at multiple levels.

In squamous epithelial malignancies, the malignant keratinocytes and surrounding stromal cells form a tumour microenvironment (TME), which is constantly subjected to the effects of intrinsic and extrinsic stressful stimuli, including endoplasmic reticulum (ER) stress. ER stress leads to the activation of the unfolded protein response (UPR). This is an evolutionarily conserved set of mechanisms designed to ameliorate the ER homeostatic imbalance or to induce cellular termination through apoptosis when ER stress cannot be mitigated. The UPR is extensively intertwined with other vital processes, including those that influence development and progression of cancer. However, at this stage, the understanding of the role of ER stress-induced UPR in the pathogenesis and progression of OSCC is still in its infancy, requiring further elucidation. In this series of investigations, it was hypothesised that: a) ER stress would differentially affect the regulation of fundamental cellular processes, i.e. the maintenance of OSCC cell viability and apoptosis and b) UPR genes and proteins would be differentially regulated, expressed and activated under the effect of ER stress in OSCC, compared to normal and dysplastic counterparts.

In order to test these hypotheses the effects of ER stress on OSCC in relation to: a) cell viability, b) direct and indirect measures of apoptosis, c) the differential regulation of 84 key UPR and ER stress-associated genes, d) the differential expression of UPR and ER stress-associated counterpart proteins and e) the resultant transcriptional activation were assessed in an established *in vitro* model using the potent inducer of ER stress, tunicamycin. Specifically seven extensively substantiated cell lines derived from normal, dysplastic and malignant oral keratinocytes were used. They were subjected to tunicamycin-induced ER stress of varying intensity and chronicity. The effects on the cell viability were determined by examining the metabolic activity of cells using a resazurin/resorufin-based cell viability assay and apoptotic responses were directly (TUNEL assay for the quantification of DNA fragmentation) and indirectly (Caspase-3/7 activity) assessed. A comprehensive set of 84 UPR-related genes were studied using a highly sensitive quantitative real-time reverse transcriptase polymerase chain reaction (qRT2-PCR) and the expression of significantly regulated protein counterparts were profiled by means of enzyme-linked immunosorbent assays (ELISA) and also by examining the DNA binding activity using a transcription factor assay (TFA).

In the cell viability experiments it was demonstrated that OSCC cells maintained cell viability in the presence of ER stress at a significantly greater level, compared to normal oral keratinocytes. Furthermore, caspase-3/7 activity and DNA fragmentation, hallmarks of cell death, were suppressed in OSCC. It was also discovered, for the first time, that UPR-induced apoptosis-related factors, most notably DDIT3, were significantly up-regulated in OSCC. Also, the master regulator of lipid metabolism, SREBP1, and CREB3L3, an ER-resident transcription factor closely related to ATF6, which plays an important role in linking ER stress with immune-inflammatory responses, were significantly up-regulated in OSCC. Both SREBP1 and CREB3L3 influence metabolic reprogramming processes, one of key hallmarks of cancer. Subsequent protein studies further substantiated the involvement of SREBP1 through the demonstration of a significantly higher level of SREBP1 activation in OSCC under ER stress. This is the first time that DDIT3, SREBP1 and CREB3L3 have been shown to be implicated in the pathogenesis of OSCC.

For the first time, this study has highlighted the importance of, and the influence of ER stress and UPR, on the pathogenesis and pathobiology of OSCC, especially centred around factors that influence apoptosis, TME and lipid metabolism. The identified factors should be further studied and validated ex vivo and, eventually, *in vivo*, in view of their potential diagnostic and prognostic role in improving the diagnosis, treatment and management of oral cancer.

Sabarinath Prasad

Vadakkedath Prasad, S. (2020). Wearable devices for jaw activity monitoring.

http://hdl.handle.net/10523/10251

The present work, which focuses on wearable devices for jaw activity monitoring is in a hybrid thesis format, whereby material published or sent for publication is inserted in the chapters of the thesis. The thesis is divided into six main chapters and owing to the nature of this thesis, a certain degree of overlap between chapters is inevitable.

Chapter 1 – General Introduction and Review of the Literature

A general overview of masticatory muscle activity in function, dysfunction and parafunction is presented in the first chapter. The review focusses on epidemiology, associated musculoskeletal conditions and methods for assessment of wake time oral parafunction. Instrument-based approaches for the assessment of wake time parafunction with a focus on portable devices for long-term masticatory muscle sEMG and approaches

for mandibular motion tracking are included in the introductory chapter

Chapter 2 – Validation of a wearable wireless device for monitoring masticatory muscle activity in freely moving individuals

The methodological details of the validation of a newly developed smartphone assisted wearable wireless EMG device are presented in the second chapter. The chapter presents an overview of the study design, participant recruitment, examination procedure, equipment used, questionnaire surveys, data analysis and limitations.

Chapter 3 – Associations among masticatory muscle activity, physical activity & self-reported oral behaviours in adult women

Objective measurements in the natural environment of masticatory muscle activity using the validated wearable EMG device and daily physical activity using wrist accelerometers are presented in the third chapter. This chapter examines the relationship between masticatory muscle activity, self-reported oral behaviours and physical activity in adult women participants. An overview of the study design, participant recruitment, examination procedure, equipment used, data analysis and study limitations is presented in this chapter.

Chapter 4– Effect of electrode characteristics on electromyographic activity of the masseter muscle.

Limitations of sensing electrodes used with the wearable wireless EMG device for long-term muscle activity monitoring are presented in the fourth chapter. The chapter presents testing of different inter-electrode distances and electrode materials to overcome limitations and optimise electrode characteristics for long-term masticatory muscle EMG with the device. An overview of the study design, participant recruitment, examination procedure, equipment used, data analysis and study limitations is presented in this chapter.

Chapter 5– Design and prototype of a new version of the wearable wireless EMG device

The fifth chapter explains the rationale, process for development and intermediate steps leading to the development of a new design of the wireless EMG device. The chapter includes the steps involved in design and prototype of the new device.

Chapter 6 – General discussion and future research directions

The sixth and final chapter of this work includes a general discussion of the research. In particular, the limitations and future directions for research are highlighted.

Doctor of Clinical Dentistry (DClinDent) completions

December 2019 graduands (by discipline)

Discipline	Student	Advisors (Primary listed first)	Thesis title	Graduated
Endodontics	Deepak Chellappa	Dr Peter Cathro Assoc Prof Geoffrey Tompkins	Endodontic applications of the metallo-drug, Auphen	Dec 2019
Endodontics	Lucy Sullivan	Assoc Prof Lara Friedlander Prof Nicholas Chandler Assoc Prof Ben Daniel Motidyang	The influence of educational information on understanding and perceptions of root canal treatment	Dec 2019
Oral Pathology	Elizabeth Tauati-Williams	Prof Alison Rich Assoc Prof Haizal Mohd Hussaini Assoc Prof Dawn Coates Dr Benedict Seo	Investigation of the presence of humanpapillomavirus in verrucal-papillary lesions of the oral cavity and comparison of viral detectionmethods	Dec 2019
Oral Pathology	Nurul Zainuddin	Assoc Prof Haizal Mohd Hussaini Prof Alison Rich Dr Benedict Seo	Neurophilin-1 expression in the tumourmicroenvironment of oral squamous cell carcinoma	Dec 2019
Oral Surgery	Adelyn Lau	Assoc Prof Rohana De Silva Prof Darryl Tong Prof Murray Thomson Dr Harsha De Silva	Third molar surgery outcomes: a comparison between submucosal and intravenous dexamethasone	Dec 2019
Oral Surgery	Oripa Waqa	Dr Benedict Seo Assoc Prof Haizal Mohd Hussaini Prof Alison Rich Assoc Prof Rohana De Silva Prof Darryl Tong	BRAF mutations in ameloblastoma: Correlation with clinical and histopathological features and behaviour	Dec 2019
Orthodontics	Ghassan Idris	Prof Mauro Farella Prof Barbara Galland Prof Rachael Taylor Dr Christopher Robertson	Eating fast and body mass index in young adolescents. Is there a relationship?	Dec 2019
Orthodontics	Wei Lin	Prof Mauro Farella Dr Joe Antoun Prof Tony Merriman Assoc Prof Ambra Michelotti	Factors associate with orthodontics pain	Dec 2019
Orthodontics	Simon Olliver	Prof Mauro Farella Assoc Prof Jonathan Broadbent Dr Joe Antoun Assoc Prof Li Mei	Long-term association of occlusal features with temporomandibular joint sounds and the incisor relationship	Dec 2019
Periodontology	Emma Morelli	Assoc Prof Jonathan Broadbent Assoc Prof Jonathan Leichter Prof Murray Thomson Dr Ellie Knight	Is parity associate with periodontal disease and other oral conditions? A longitudinal study	Dec 2019
Prosthodontics	Siddarth Kothari	Prof Paul Brunton Prof Karl Lyons Mr Andrew Gray	Vital bleaching (at-home, in-office, in-office +at home), colour change and oral health related quality of life	Dec 2019
Prosthodontics	Huda Mohammed	Prof Neil Waddell Prof Karl Lyons Dr Kai Li	Bond strength of a direct composite resin to resin-matrix ceramic materials with four surface treatments	Dec 2019
Special Needs Dentistry	Hamid Mohammed	Prof Murray Thomson Prof Alison Rich Mr Graeme Ting	Oral health of older people	Dec 2019
Special Needs Dentistry	Nurulhuda Mohd Thiyahuddin	Prof Richard Cannon Dr Erwin Lamping Prof Alison Rich Mr Graeme Ting	Yeast species in the oral cavities of olderpeople	Dec 2019
Special Needs Dentistry	Arunadevi Ramasamy	Dr Lee Adam Mr Graeme Ting Prof Alison Rich	Perceptions of special needs dentistry amongst the general dentists in New Zealand	Dec 2019

December 2020 graduands (by discipline)

Discipline	Student	Advisors (Primary listed first)	Thesis title	Graduated
Endodontics	Finn Gilroy	Assoc Prof Lara Friedlander Prof Nicholas Chandler Assoc Prof Ben Daniel Motidyang	Perceptions of general health and root canal treatment in New Zealand general dental practice	Dec 2020
Endodontics	Payman Hamadani	Assoc Prof Lara Friedlander Prof Nicholas Chandler Assoc Prof Ben Daniel Motidyang	Managing older adults requiring endodontic treatment. A New Zealand practice-based research network study	Dec 2020
Oral Surgery	Jessica Lee	Dr Harsha De Silva Assoc Prof Rohana De Silva Prof Darryl Tong Prof Murray Thomson	Pre-emptive efficacy of sustained-release ibuprofen and etoricoxib in third molar surgery	Dec 2020
Orthodontics	Rachel Farrar	Prof Mauro Farella Dr Joe Antoun Prof Warwick Duncan Dr Fiona Firth Dr Birte Melsen	Development of an ovine model to investigate orthodontic tooth movement in 3D	Dec 2020
Orthodontics	Danielle Hodgkinson	Prof Mauro Farella Assoc Prof Li Mei Dr Joe Antoun Dr Austin Kang	Perioral soft-tissues in orthodontics	Dec 2020
Orthodontics	James Millar	Assoc Prof Li Mei Prof Mauro Farella	Management of biofilm formation with Airflow in patients with fixed orthodontic appliances	Dec 2020
Orthodontics	Grace Nichols	Assoc Prof Jonathan Broadbent Prof Mauro Farella	Psychosocial effects of malocclusion from adolescence to adulthood	Dec 2020
Paediatric Dentistry	Yvonne Golpak	Ms Alison Meldrum Ms Dorothy Boyd Assoc Prof Mani Ekambaram	Effectiveness of bi-annual application of 38% silver diamine fluoride and 5% sodium fluoride varnish on primary teeth of children, in a rural setting near Port Moresby, Papua New Guinea - A randomised clinical trial	Dec 2020
Paediatric Dentistry	Yu-Lynn Lee	Assoc Prof Mani Ekambaram Ms Dorothy Boyd Dr Kai Li	Bonding universal dental adhesive to developmentally hypomineralised enamel	Not yet graduated
Periodontology	Anumala	Dr Trudy Milne Prof Warwick Duncan Assoc Prof Dawn Coates	Osteogenic marker expression in a grafted bone healing sheep model	Dec 2020
Periodontology	Saeideh Nobakht	Assoc Prof Dawn Coates Dr Trudy Milne Prof Warwick Duncan	Pleiotrophin family gene and protein expression in a sheep tooth socket model of bone healing	Dec 2020
Periodontology	Tatiana Tkatchenko	Prof Warwick Duncan Assoc Prof Dawn Coates Dr Trudy Milne	Radiographic and histomorphometric evaluation of an ovine forestomach matrix combined with Bio-Oss bone graft in a sheep tooth extraction model	Dec 2020

DClinDent thesis abstracts

Anumala

Anumala. (2020). Osteogenic marker expression in a grafted bone healing sheep model.

http://hdl.handle.net/10523/10570

Objectives: Successful healing of alveolar sockets after tooth extraction ensures positive outcomes for tooth replacement options. Using a sheep model the expression levels of key osteogenic markers for healing were compared over 16-weeks for empty and grafted sockets.

Methods and Materials: First, second and third premolars were extracted from 30 sheep. The socket was either non-grafted for spontaneous healing (control) or grafted using Bio-Oss® and Bio-Gide® (test). After 4-, 8- and 16-weeks the sheep were euthanised and tissue samples collected. Histological analysis was undertaken and cellular localisation of receptor RANK, and ligands RANKL and OPG was determined using immunohistochemistry. mRNA expression levels for RANK, RANKL, OPG, Col1A1, TIMP3, Sp7 and Msx2 were determined using SYBR green RT2-qPCR assays.

Results: Overall, more new woven bone was present in the test group compared to the control at all time points. Moderate immunopositive staining of RANK was associated with osteoblasts and osteoclasts in both groups at 4 weeks; with stronger osteoclast-associated staining in the test group at 8- and 16-weeks. Strong staining of RANKL associated with osteoblasts and osteoclasts was found in both groups at all time points. Initial strong OPG staining localised to the connective tissues

decreased over time. Similar levels of mRNA expression in both groups for all seven osteogenic genes was found. The exception was RANK with expression levels lower in the test group compared to the control group at 4-weeks (P = 0.02). Sp7 was also expressed significantly lower in test group at 16-weeks (P = 0.04).

Conclusion: Histologically more woven bone was present in test sockets likely due to the lower level of RANK expression resulting in decreased osteoclastic activity. There was, however, no statistically significant difference in the expression of the key markers of osteogenesis, RANKL and OPG between empty and grafted sockets at any time over the 16-week period. There was also no difference in the expression of the transcription factor for osteoblast differentiation MSX2 or the ECM markers Col1A1 or TIMP3.

Although Bio-Oss® is not osteoinductive, it has osteoconductive and scaffolding properties, playing a role in alveolar ridge preservation and therefore, its use should be continued.

Deepak Chellappa

Chellappa, D. (2019). Endodontic applications of the metallo-drug, Auphen..

http://hdl.handle.net/10523/9684

Background: Root canal treatment requires adequate removal of the infection-causing microorganisms within the intraradicular system. Conventional root canal treatment involves mechanical debridement, using hand and rotary instruments, in conjunction with antimicrobial solutions to decrease the bacterial load to an acquiescent level. Between appointments, medicaments are regularly injected into the root canal space for continued antimicrobial action and to prevent bacterial repopulation. However, the ideal irrigant or medicament does not exist, as many possess cytotoxic properties that can damage the hosts tissues, leading to an inflammatory response.

Metallo-drugs, particularly Auphen, impart minimal side-effects on host cells when used in small dosages. Auphen targets aquaporins; present in human cells, plants and bacteria; and has been previously trialled in anti-cancer and rheumatoid arthritis treatment. Aquaporins are channels that regulate the inward and outward movement of water and glycerol across the cytoplasmic membrane. Auphen binds to the aquaporin within the channel, inhibiting its function, leading to cellular instability and death. The antibacterial applications of Auphen in endodontics have yet to be assessed.

Aim: The aim of this study was to analyse the ex vivo antibacterial efficacy of Auphen combined with an injectable hydrogel carrier (Poloxamer 407®) against two common bacteria associated with root canal infection.

Methodology: Two species, Streptococcus gordonii and Streptococcus mutans, were sourced from frozen glycerol stocks provided by the Department of Oral Sciences Culture Collection (University of Otago, NZ). An aqueous solution of Auphen at varying concentrations was prepared and the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) determined using a broth microdilution assay. Auphen was incorporated into Poloxamer 407 (P407) gels at 25% (w/v) and the gel stability evaluated. The ex vivo release profile of Auphen from the P407 formulations and the gel dissolution profile were obtained using inductively coupled plasma-mass spectroscopy (ICP-MS). The antimicrobial efficacy of Auphen in a P407 gel formulation was assessedon planktonic cell cultures and on mono-species biofilms using a resazurin metabolic biofilm assay. MIC and MBC comparisons were made between Auphen (aqueous and gel state) formulations, saturated calcium hydroxide, sodium hypochlorite and sterile water.

Results: Stable Auphen-loaded P407 gels were successfully prepared. ICP-MS analysis indicated a linear release of Auphen from the dissolving P407 gel over the 7-day period. Aqueous Auphen ≥ 0.5 mM completely inhibited the growth of both species after antimicrobial exposure.

Auphen retained its antimicrobial activity when incorporated with P407 gel, with both species of Streptococcus susceptible at the same concentration (MIC 0.1 mM, MBC 0.5 mM). Both aqueous Auphen and Auphen-loaded gels impaired growth of biofilm at concentrations ≥ 0.05 mM.

The viability of mono-species biofilms after 24-hours exposure to Auphen (≥ 0.1 mM) in both aqueous and gel-form was comparable to sodium hypochlorite, completely inhibiting growth. Saturated calcium hydroxide slowed growth of both Streptococcus biofilms but did not completely inhibit growth.

Conclusions: Aqueous Auphen and Auphen-loaded P407 gel at 0.5 mM resulted in antimicrobial activity against both planktonic cultures and mono-species biofilms of S. gordonii and S. mutans. Auphen (≥ 0.5 mM), in both aqueous and gel form, resulted in superior antimicrobial ability compared to saturated calcium hydroxide. Within the limitations of this study, Auphen in a polymer gel demonstrates potential for use as an antimicrobial agent in the treatment of root canal infections.

Rachel Farrar

Farrar, R. F. (2020). Development of an ovine model to investigate orthodontic tooth movement in 3D.

http://hdl.handle.net/10523/10562

Small animal models, including rats and mice, have been used in orthodontic research for over a century. Investigating orthodontic tooth movement (OTM) in small animals is very challenging and the translational significance of findings from rodents to humans is dubious. A sheep model may represent a suitable large animal model for investigating OTM.

The pressure-tension theory of OTM is supported by animal research and has long been accepted. More recently, however, a new paradigm has been proposed. According to Frost's mechanostat theory, the pattern of alveolar bone remodelling changes with the magnitude

and distribution of stress within the periodontium, which in turn depends on the modality of tooth movement (e.g. tipping vs bodily). To the best of our knowledge, there is no available information relating tooth movements, as they actually occur in three dimensions (3D), with alveolar bone turnover and associated histological changes.

Aims: The primary aim of this thesis was to develop a model in the ovine mandible to investigate tooth movement. It was tested by moving teeth orthodontically and describing the outcomes in 3D.

Methods: In six Romney-cross ewes, the lower first and third premolars were extracted, and fiducial markers placed. Impressions were acquired for construction of customised orthodontic appliances. Two appliances were designed, to achieve a range of moment-to-force ratios and therefore tooth movement modalities. After six weeks, each sheep received one of each appliance, randomly allocated to the left and right sides. The lower second premolars were moved mesially, into the healed edentulous space. After twelve weeks, the sheep were euthanised and histological specimens obtained. Sequential CT scans were acquired and registered. Tooth movement between two time-points and associated changes to the alveolar bone were assessed in 3D. The registered teeth were segmented axially and matched with equivalent histological slides, enabling identification of stress vs strain surfaces and description of the surrounding periodontal tissues.

Results: Appliance retention was the greatest challenge, with a mean appliance survival of 8.8 weeks (SD 2.4). All appliances lasted a minimum of four weeks with two remaining in situ at the completion of the study. A variety of tooth movements were achieved with a mean crown movement of 6.4 mm (range 1.8-13.0 mm) and mean root apex movement of 2.7 mm (range 1.1-4.8 mm). The approach whereby the registered teeth were "matched" to the equivalent histological slides was successful. New bone was identified on the "pressure" surface on multiple slides.

Conclusion: It is possible to move teeth orthodontically in the ovine mandible and describe the movement in 3D. Registered 3D imaging can be merged with equivalent histology, the pressure and tension surfaces identified, and site-specific bone remodelling compared.

Finn Gilroy

Gilroy, F. G. (2020). Perceptions of general health and root canal treatment in New Zealand general dental practice.

http://hdl.handle.net/10523/10574

There are common risk factors between general health and oral health. General dental practitioners (GDPs) are seeing increasing numbers of patients presenting with multiple complex medical conditions. In parallel to managing more medically compromised patients, GDPs must provide holistic and technically challenging root canal treatment (RCT) for teeth that are heavily restored. There is little evidence surrounding the health status and preferences of patients undergoing RCT, and the confidence of GDPs in managing them.

This mixed method research engaged both dentists and their patients in a translational approach within a practice-based research network (PBRN). The goals of this study were to examine the self-perceived confidence and competence of New Zealand (NZ) GDPs managing patients for RCT presenting with a range of medical conditions; and their engagement in continuing professional development (CPD) related to endodontics. It also considered the dental experiences and self-perceived general health status of patients requiring RCT.

This study had three parts: A Pilot study, a PBRN survey of GDPs and patients, and Focus Group interviews of GDPs. Quantitative data from the surveys were entered directly into IBM SPSS Statistics Software, and following descriptive analysis, bivariate analysis was used to quantify differences in proportions using Pearson's Chi square test. Qualitative data was analysed thematically. Focus Group interviews were transcribed verbatim and transferred to NVivo 12 for detailed analysis.

The Pilot study validated the reliability of the survey for use in a larger group. The PBRN survey was implemented in a range of general practices throughout NZ and provided self-reported demographic and health data from patients, as well as perceptions of their oral health and wellbeing. A positive patient experience of RCT was mostly influenced by clear, empathetic communication, and a professional approach by the practitioner.

GDP confidence in providing RCT was strongly related to procedural and patient-related factors rather than specific medical conditions such as those readily controlled with medications including cardiovascular diseases, and diabetes mellitus. The development of CPD related to medical conditions and pharmacology in dentistry was perceived as important.

With the help of both dentists and patients, this study has provided new knowledge, and improves our understanding of patients' medical status when they present for RCT and how equipped our workforce is to manage endodontic patients. Together this information can inform development of CPD activities and assist NZ GDPs managing patients requiring RCT.

Yvonne Golpak

Golpak, Y. (2020). Effectiveness of bi-annual application of 38% silver diamine fluoride and 5% sodium fluoride varnish on primary teeth of children, in a rural setting near Port Moresby, Papua New Guinea - A randomised clinical trial.

http://hdl.handle.net/10523/10555

Aim: To assess the effectiveness of 38% silver diamine fluoride (SDF) solution and 5% sodium fluoride (NaF) varnish applied bi-annually in arresting carious lesions in primary teeth of children and to assess child and parent acceptability of the treatments.

Methods: Children aged 2-5 years with at least one carious lesion were randomly allocated into 2 groups as follows: Group 1 received 38% SDF (Riva star SDI

Ltd) solution and Group 2 received 5% NaF varnish (Duraphat®), applied at baseline and again at 6 months. Lesion progress or arrest was assessed by visual and tactile examination at 6 months and 12 months. Parental and child satisfaction were assessed with self-reports at 6 months and 12 months.

Results: One hundred and four children were recruited. Baseline mean dmfs scores were 10.8 and 11.7 for Group 1 and 2 respectively. At 12 months, 86.5% (90) participants remained in the study. The caries arrest rate in SDF group, was higher than that of NaF group, 97.2% vs 71.5 % ($p < 0.001$). Logistic regression analysis showed that 38% SDF was more effective than the 5% NaF varnish (OR: 7.7, 95% CI=3.14 -19.09) in arresting carious lesions. There were no differences in parental and child satisfaction between the groups.

Conclusion: At 12 months, both 38% SDF and 5% NaF were effective in arresting dental carious lesions, however 38% SDF was superior to 5% NaF. Parents and children were accepting of the treatment provided.

Payman Hamadani

Hamadani, P. S. (2020). Managing older adults requiring endodontic treatment. A New Zealand practice-based research network study.

http://hdl.handle.net/10523/10566

New Zealand (NZ) has an ageing population and like most countries, this is expected to increase. Many older adults (65+ years), including those with comorbidities, are retaining their teeth into old age, meaning treatment planning and management of these patients is often complex. The scope of endodontics encompasses the prevention or treatment of apical periodontitis and enables preservation of the natural dentition. There is a limited understanding of the preparedness of the NZ general dental workforce to manage the endodontic needs of older adults.

The last national survey of endodontics among NZ dentists was reported over 17 years ago and it indicated that general dental practitioners (GDPs) provided endodontic treatment but technology, management philosophies and health in older adults has changed over time. Further, there is no recent information about NZ practice to guide clinical decision making.

This Practice-Based Research Network study used a mixed-methods approach to better understand the endodontic needs of older adults and the challenges faced by GDPs in NZ. An online national survey was followed by focus group interviews with dentists who had varying experience levels and resided in main centres and regional areas of NZ. The specific objectives included investigating GDP philosophies, knowledge, practices, attitudes (including ageism) when managing older adults requiring endodontic treatment. Alongside this, the role of GDPs in providing domiciliary care and Continuing Professional Development (CPD) activities were also investigated.

The survey collected quantitative and qualitative data from 382 GDPs (response rate 23.3%). Findings were analysed using SPSS and NVivo software. The emerging themes from the survey guided the face-to-face focus group interviews which provided deeper understanding and context to the survey responses.

The results from the survey and focus groups showed that GDPs enjoyed treating older patients, however patients with a reduced cognitive ability rendered dental management 'more complex', 'requiring more skill and patience'. Many GDPs expressed that the dental needs of older adults in residential care is significant, however the ability to provide care is limited. The endodontic requirements of older adults varied, with most patients wanting to retain their teeth, however 'self-ageism' was a barrier in many instances. Cost of root canal treatment (RCT) was a significant barrier for many patients with some clinicians electing to carry out vital pulp therapy as an interim means of managing their problem. Most GDPs performed RCT and teeth identified as difficult preoperatively (e.g. calcified canals, retreatment or especially strategically important teeth) were referred to specialist endodontists for management.

The outcomes from this study can be translated to clinical practice, with a desire by most GDPs to undertake further CPD related specifically to the management of older adults with medical problems, and patient centred treatment planning.

Danielle Hodgkinson

Hodgkinson, D. R. E. (2020). Perioral soft-tissues in orthodontics.

http://hdl.handle.net/10523/10578

The effect of orthodontic extractions on the face has been a contentious issue in orthodontics for over a century. The soft-tissue properties of the lips have often been cited as a factor affecting the facial response to orthodontic tooth movement.

The first part of this project was an observational study using a hand-held myotonometric device to measure the soft-tissue properties of the lips, and found variability between age, sex, BMI, anatomic site, lip morphology, and craniofacial morphology.

The second part was a pilot study that successfully designed a non-invasive, retrospective method to investigate the three-dimensional response of the soft tissues to incisor retraction. Despite marked interindividual variation among the small sample, the lip retraction was consistently less than the amount of incisor retraction.

Ghassan Idris

Idris, G. (2019). Eating Fast and Body Mass Index in Young Adolescents. Is there a relationship?

http://hdl.handle.net/10523/9738

Behavioural aspects of chewing may influence food intake, nutritional status, and, in turn body weight. Obesity is highly prevalent among New Zealand adolescents, it is also a concern globally, as it impacts negatively on children's health. The aims of the current study were: 1) To study the chewing features in a group of adolescents, as they naturally occur in home-based settings; 2) To test for a possible association between chewing features and body weight.

Forty-two participants (20 females and 22 males) aged 15.3 ± 1.3 year were recruited for this study. Based on a Z-score for Body Mass Index (BMI), half of the study participants (n = 21) were classified as being in a healthy weight range, while the other half were considered overweight-to-obese. Using a smartphone-assisted wearable electromyographic (EMG) device and a wearable camera, the participants' chewing features were assessed for one evening, including the evening meal, in their homes. The outcome variables included chewing pace, chewing duration, and the number and power (intensity) of chewing strokes.

Eating episodes could be accurately detected by both the EMG device and the wearable camera, with accuracy values ranging from 0.8 to 0.92. The EMG device, however, was more sensitive and could identify chewing episodes not detected by the camera. The chewing features (mean ± SD), as evaluated by EMG, showed a chewing pace of 1.53 ± 0.22 Hz, a chewing time of 11.0 ± 7.7 minutes and a frequency of chewing episodes of 63.1 ± 36.7 per evening (from + 5:00 pm until bedtime). The mean chewing power was 30.1 ± 4.8 %. There was a negative correlation between BMI and chewing pace (R= -0.42; P < 0.001) and between the BMI and chewing time (R = -0.32; P = 0.026). The results of the current study indicate that overweight-to-obese adolescents tend to eat in a shorter time and at a slower pace than their healthy weight counterparts.

Siddharth Kothari

Kothari, S. (2019). Vital bleaching (at-home, in-office, in-office + at home), colour change and Oral Health-Related Quality of Life.

http://hdl.handle.net/10523/9792

Objectives: This randomised clinical trial compared tooth colour change, participant satisfaction and Oral Health-Related Quality of Life (OHRQoL) following application of at-home, in-office and combined at-home and in-office bleaching treatments. Participants were followed up at 15 days and 3 and 6 months after bleaching.

Methods: A group of 105 participants was recruited and randomly assigned to receive a combination of at-home and in-office (group A), in-office (group B) or at-home (group C) teeth bleaching treatments. At-home bleaching was performed using custom-made bleaching trays in conjunction with 10% carbamide peroxide (CP) gel for 14 days. In-office bleaching was performed using 37.5% hydrogen peroxide (HP) applied in three cycles, each lasting 8 minutes. The combination of at-home and in-office bleaching treatment involved in-office followed by at-home. Tooth colour change was assessed visually with Vita classical shade guide and using a digital spectromonometer. Participants' perception of their own oral health, smile and straightness and whiteness of teeth and Oral Health-Related Quality of Life (OHRQoL) were evaluated by means of self-reported questionnaires. Parameters/responses were evaluated/collected prior to bleaching and at every recall visit. Statistical analyses were applied as appropriate to collected data. Significance level was set at 5%.

Results:
Change in colour - Combination group treatment resulted in significantly higher shade difference at 15 days recall when assessed using Vita classical shade guide and Spectromonometer ($p<0.007$). At 3 months recall, participants in group B demonstrated darker teeth compared to the other two groups, measured by visual and digital method ($p<0.001$). At 6 months there was no difference between groups C and A participants' teeth colour measured by Vita classical shade guide ($p<0.01$). Significant improvement to tooth colour was observed among all groups at 6 months recall ($p<0.01$). Self-perception of oral and dental health and satisfaction with smile and whiteness of teeth was significantly improved following all bleaching protocols ($p<0.001$). Satisfaction levels with straightness of teeth were significantly improved only in patients younger than 40 years in the combination and in-office bleaching protocols ($p<0.012$).

Change in Oral Health-Related Quality of Life - the change in OIDP questionnaires was apparent for the 3- and 6-month follow-up visits ($p<0.01$), with the frequency of impacts decreasing after the bleaching treatments. The greatest reduction was seen for activities related to laughing and showing teeth without embarrassment, followed by eating and hygiene at the end of 6 months ($p<0.01$). The changes in the OHIP-aesthetic questionnaires were apparent in the short duration (3 months) ($p<0.014$), with the greatest improvement in functional, psychological discomfort and handicap ($p<0.014$). The improvement remained constant during all evaluations.

Conclusion: Change in tooth colour is faster using the combination bleaching treatment in a short-term period, while in the long-term there is no difference between the combination and at-home teeth bleaching protocols. With the tested bleaching products, in-office treatment should be supplemented with at-home bleaching. Self-perception of OHRQoL is higher for participants in the combination therapy and remained constant during all follow-up visits.

Adelyn Lau

Lau, A. (2019). Third molar surgery outcomes: a comparison between submucosal and intravenous dexamethasone.

http://hdl.handle.net/10523/9783

Objective: To compare the efficacy of submucosal (SM) dexamethasone and intravenous (IV) dexamethasone in reducing postoperative facial swelling, pain and trismus after third molar surgery, and its impact on quality of life.

Methods: The study was designed as a randomised, controlled, observer-, surgeon- and participant-blinded single-centre equivalence trial with two parallel groups. There were 61 participants in the IV group and 64 participants in the SM group. The IV group received 2ml intravenous saline and 8mg/2ml submucosal dexamethasone. The SM group received 8mg/2ml intravenous dexamethasone and 2 ml saline submucosal injection. Facial swelling was measured using a contactless stereophotogrammetry 3-dimensional facial camera (3dMD Inc, Atlanta, GA). These images were superimposed and analysed to calculate the volumetric difference in facial swelling. Pain was measured using a 100mm visual analogue scale (VAS). Maximum incisal distances were measured using a linear calliper. All measurements were taken immediately before the surgery and on postoperative days 2 and 7. Data were collected from participants by means of self-reported questionnaires. This study used the oral health impact profile (OHIP)-14 and a third-molar-specific oral-health-related quality of life (OHRQoL) instrument to assess changes to quality of life. Demographic and clinical characteristics of the participants were cross-tabulated and analysed by analysis of variance (ANOVA) or Pearson Chi-Square, as appropriate. P values of <0.05 were considered statistically significant.

Results: On day 2, the IV and SM group had a mean facial swelling of 7.3 cm3 and 7.8 cm3, respectively. On day 7, the swelling had reduced to 2.9 cm3 in the IV group, and 2.6 cm3 in the SM group. Mean pain scores did not differ between treatment groups on either postoperative days. Trismus was most severe on postoperative day 2 in both groups. The amount of trismus observed at both postoperative follow-up time points was similar between the groups. There were no statistically significant differences between the two groups. Both groups experienced poorer quality of life following third molar surgery. The degree of impact on quality of life was comparable between the treatment groups.

Conclusions; There are no differences in postoperative adverse outcomes between submucosal and intravenous administration of dexamethasone in third molar surgery. Submucosal dexamethasone is a straightforward, accessible and viable route of delivery of steroid administration in patients who choose to have third molar surgery under local anaesthesia only.

Jessica Lee

Lee, Y. J. (2020). Pre-emptive efficacy of sustained-release ibuprofen and etoricoxib in third molar surgery.

http://hdl.handle.net/10523/10573

Objective: To compare the effect of pre-emptive administration of sustained-release (SR) ibuprofen 1.6g and etoricoxib 120mg on pain, swelling, trismus, and the quality of life following impacted third molar surgery.

Methods: In this single-centre, double-blinded randomised control trial, participants were randomly assigned to receive oral SR ibuprofen 1.6g or etoricoxib 120mg 2 hours before third molar surgery. In the first 48-hour postoperative period, participants rated their pain intensity every 3 hours, while awake, and recorded their use of rescue analgesia. A preoperative and 48-hour time point measurements were taken for facial swelling, trismus, and the quality of life. The postoperative facial swelling was determined by the volumetric differences between the pre- and postoperative 3D photographs of the participants, using the 3dMDtrio system (3dMD, Atlanta, GA). Trismus was assessed indirectly, by measuring the pre- and postoperative interincisal distances at the maximum mouth opening. The quality of life was assessed using the short-form Oral Health Impact Profile (OHIP-14). Categorical data of the two study groups were compared using Chi-square tests. Clinical characteristics were compared and tested for statistical significance using Analysis of variance. A P value of less than 0.05 (P<0.05) was considered statistically significant.

Results: Study sample included 135 participants: SR ibuprofen (n=68) and etoricoxib (n=67). Despite observing an overall slightly higher pain level in the SR ibuprofen group than the etoricoxib group throughout the study period, the difference was not statistically significant. Just over 50% of participants in both groups required rescue analgesia (p=0.78), while the mean time to first rescue analgesia was 5 hours postoperatively (p=0.66). The total number of rescue analgesics consumed was comparable between the two groups (p=0.14). There were no significant differences between the two groups in facial swelling (p=0.80), trismus (p=0.86), and the mean OHIP-14 score (p=0.26).

Conclusion: With no significant differences observed between the performance of the two drugs in acute postoperative sequelae, pre-emptive administration of the more economical SR ibuprofen could be used as a suitable alternative to etoricoxib in third molar surgery.

Yu-Lynn Lee

Lee, Y.-L. (2020). Bonding universal dental adhesive to developmentally hypomineralised enamel.

http://hdl.handle.net/10523/10557

Previously referred to as “cheese molars”, “dysmineralised permanent first molars”, “idiopathic hypomineralisation” and “non-fluoride hypomineralisation”, the term “Molar Incisor Hypomineralisation” (MIH) was first introduced

by Weerheijm and colleagues in 2001 to describe the characteristic clinical appearance of demarcated opacities, altered translucency, and qualitative defects within dental enamel. A developmental dental defect of systemic origin, MIH invariably affects one to four first permanent molars with or without involvement of the permanent incisors. With global prevalence rates ranging from 0.48% to 40.2%, it is a common condition that affects approximately one in six children in New Zealand.

Despite extensive research efforts, the aetiology and clinical management of MIH remain indeterminate. As MIH-affected teeth have compromised chemomechanical properties, restorative treatment outcomes are often unpredictable, thus requiring multiple re-interventions over the years. The debilitating sequelae and negative impact of MIH on children have been well documented in the literature; therefore, the overarching drive of this research is to alleviate the healthcare burden of MIH on affected individuals.

The first study was an in vitro experiment that investigated the effect of a pretreatment protocol involving the concurrent use of a papain-based deproteinising agent (Papacarie Duo gel) and a contemporary universal dental adhesive resin (3M ESPE Scotchbond Universal Adhesive) on the microshear bond strength of resin composite to hypomineralised enamel. The three primary hypotheses tested were: (1) there would be a difference in bond strength between normal enamel and hypomineralised enamel, (2) deproteinising pretreatment with Papacarie Duo gel would increase the bond strength to resin composite, and (3) there would be a difference in bond strength between etch-and-rinse mode and self-etch mode of Scotchbond Universal Adhesive.

After assessing and confirming the eligibility of each participant, extracted first permanent molars with a known clinical diagnosis of MIH were collected from Paediatric dental specialists across New Zealand over a 13-month period. Upon receipt, the teeth were cleaned, stored, sectioned and prepared in accordance with the approved research methodology. A total of 88 clinically sound "normal" enamel specimens, and 96 hypomineralised enamel (48 creamy/white, 48 yellow/brown) specimens were included in both studies. Following the MIH judgment criteria (EAPD 2003), two independent examiners visually inspected and identified the specimens, which were subsequently randomised and allocated into one of the eight experimental groups.

The results supported both hypotheses and established the conclusive facts that the application of Scotchbond Universal Adhesive in etch-and-rinse mode and the pretreatment of hypomineralised enamel with Papacarie Duo gel led to a marked increase in microshear bond strength values. Analysis of failure modes under scanning electron microscope further reaffirmed the research findings.

The second study was another in vitro experiment which evaluated the surface morphology and nanotopography of 8 representative normal enamel and 16 hypomineralised enamel (8 creamy/white, 8 yellow/brown) specimens. Following the protocol of their respective experimental groups, the enamel specimens were pretreated with different etching modes (i.e., etch-and-rinse or self-etch) of 3M ESPE Scotchbond Universal Adhesive and/or Papacarie Due gel. The investigation involved the quantitative measurement of surface roughness using atomic force microscopy as well as the qualitative examination of enamel surface aberrations under scanning electron microscopy. The two hypotheses tested were (1) deproteinising pretreatment using Papacarie Due gel would lead to qualitative and quantitative changes on the enamel surfaces of all substrates, and (2) there would be morphological and topographic differences between phosphoric acid etching and Scotchbond Universal Adhesive when applied in SE mode.

In spite of limited data, the results supported the hypothesis. Yellow/brown hypomineralised enamel recorded higher surface roughness values than their normal enamel and creamy/white hypomineralised enamel counterparts due to microscopic post-eruptive breakdown of enamel that was not readily discernible. In addition, the deproteinisation of hypomineralised enamel with Papacarie Duo gel followed by acid etching with 37% phosphoric acid produced uniform etching patterns that were comparable to those of normal enamel.

Consolidating the findings from these two studies, it is evident that Papacarie Duo gel and acid etching (i.e., etch-and-rinse mode) are two independent factors that have a profound effect on the in vitro bonding efficacy of hypomineralised enamel to resin-based universal dental adhesives. Although further investigations are warranted, it is expected that the integration of these dental materials into the clinical management of MIH will lead to favourable treatment outcomes. This is in line with the overriding purpose of the research project – to determine a pretreatment protocol that has the potential to reduce the likelihood of traumatic dental experiences and ultimately, improve the quality of life of affected children and families.

Wei Lin

Lin, W. (2019). Factors associated with orthodontic pain.
http://hdl.handle.net/10523/9770

Introduction: The amount of pain experienced during orthodontic treatment varies largely over time and between individuals and can affect a patient's compliance, ability to chew, well-being and sleep quality. The reasons for the inter-individual variability in pain are largely unknown: clinical force activation, demographic psychological characteristics and genetic polymorphism of candidate genes are putative factors that may account to explain this variability.

Objective: The aim of this study was to investigate the effect of clinical, demographic, psychological and genetic factors on pain levels experienced during fixed orthodontic treatment.

Method: A convenience sample of 183 patients undergoing full fixed orthodontic treatment at the University of Otago, Discipline of Orthodontics were recruited for this study. Participants pain levels were assessed seven times over a three-day period via a smartphone App on an issued research smart phone.

Clinical, demographic and psychological data were collected via questionnaire. This included the Pain Catastrophising Scale (Child Version); the Corah Dental Anxiety Scale and the State and Trait Anxiety Inventory. Participants provided a DNA sample either in the form of blood or saliva, which were used for genotyping COMT gene rs6269, rs4680, rs4646310, NR3C1 gene rs2963155 and the HTR2A gene rs9316233.

Results: Bond ups had the greatest influence on perceived levels of orthodontic pain, accounting for 20% of total variance in pain response. High pain responders had higher scores on pain catastrophizing (magnification subscale). Self-reported pain during fixed orthodontic treatment was not influenced by gender, age, time into treatment, anxiety, nor by polymorphisms of HTR2A or NR3C1 gene. AA genotype of COMT rs4646310 had higher pain levels compared to the GG and AG genotypes (p=0.048).

Conclusions: Orthodontic pain is stronger during bond ups and in patients with high catastrophizing scores. Demographics, type of clinical activations and the genetic polymorphisms investigated in this study had little impact on perceived pain levels.

James Millar

Millar, J. R. (2020). Management of biofilm formation with Airflow in patients with fixed orthodontic appliances.

http://hdl.handle.net/10523/10577

Introduction: Orthodontic braces imped patient oral care and promote dental plaque accumulation. If left to mature, dental plaque will result in gum inflammation and eventually enamel damage. Current preventative treatments remain inadequate with an unacceptable proportion of orthodontic patients having enamel damage post treatment. The air-polishing based technique of Air-Flow offers considerable potential as an effective intervention, that could prevent these adverse outcomes in the future.

Materials and Methods: A prospective, single-blind randomised controlled trial was conducted. Participants were randomly allocated to two-groups and treatment conducted as per a split-mouth design. The intervention of interest was air-polishing via the Air-Flow Handy 3.0 Plus handpiece (EMS, Switzerland) with an erythritol based powder. The comparison intervention was guided toothbrushing following plaque disclosure and oral hygiene instruction. Outcome measures included the Gingival index (GI), Plaque Index, average fluorescence loss, and white-spot lesion area as recorded via quantitative light-induced fluorescence.

Results: Both interventions resulted in a reduction of GI scores from baseline to the end of the trial. No statistical significance was found between either intervention and GI scores were not significantly influenced by sex or by time. Pre- and post-intervention plaque score change was consistently two-fold greater reduction in the Air-Flow treatment compared to OHI, for all time intervals. Changes in fluorescence and white-spot lesion size do not differ significantly between either Air-flow or OHI treatments.

Conclusion: Both techniques reduce plaque levels in patients wearing fixed orthodontic appliances. Air-flow is twice as effective at removing plaque compared to OHI at the time of intervention. However, the effect of increased plaque removal, over a five month period, appears to be clinically insignificant with respect to gingival health and enamel demineralisation. In the constraints of this trial, air-polishing does not appear superior as a biofilm management tool compared to the current standard.

Hamid Mohammed

Mohammed, H. S. (2019). Oral health of older people.

http://hdl.handle.net/10523/9732

The population of older people in New Zealand is increasing. With advancing age, older people are more likely to develop some form of disability. More and more older people are retaining their teeth, but epidemiological evidence indicates that oral disease continues older people are considered a caries-active group. There are marked differences in the oral health status of community dwelling and nursing home residents, with treatment needs higher in the latter. To date, little is known about clinical presentations of older people (community dwelling and nursing home residents) to hospital dental departments in New Zealand. There are currently no data describing the demographic characteristics, sources of referral and the nature of dental treatment provided to older people presenting to hospital dental departments in New Zealand. Keeping this theme in mind, I undertook this study to answer the following research questions:

1. What is the status of oral health among older people living in New Zealand; and
2. What are the barriers to dental care among older people living in New Zealand?

This study was conducted in two parts. The first part of this study was an 8-month clinical audit at Waikato Hospital Dental Department to determine:

1. The demographic characteristics, source and reasons for referral, dentition status of the older people (>65 years of age) presenting to the Dental Department of Waikato Hospital; and
2. The nature of their dental problems, the treatment received and the follow-up care.

The second part of this study was a secondary analysis of the 2012 older peoples' national oral health survey data. The second part of this study was conducted to:

1. Describe older New Zealanders' use of dental services; and
2. Determine any difference in the nature of dental problems, and barriers to dental care among older adults in community-dwelling and Residential care facilities.

Methods: For the first part of the study, information on patients aged 65 or more who presented to the dental department from 1st February to 31st October 2018 was abstracted from the Waikato DHB clinical database.

Data analysed included demographic characteristics, dentition status, source of referral, medical history, treating clinician, treatment delivered and whether there was follow-up care. This information was then entered a data capture form and numerically coded. The IBM SPSS (Statistical Package for the Social Sciences) for Windows program was used for the analysis of the data.

The data for the second part of this study were obtained from the 2012 New Zealand Older People's Oral Health Survey (OPOHS) data dictionary. The 2012 OPOHS was part of the Study into Older People's Oral Health Issues; an umbrella project funded by the Ministry of Health. The 2012 OPOHS was the first nationwide survey to collect information on the oral health status of older adults in New Zealand, residing in community-dwelling and residential aged-care facilities. In addition to ascertaining the clinical and self-reported oral health status of vulnerable older adults, the 2012 OPOHS also reported on the oral health services accessed by them. The Stata statistical software package (Stata Corp for Windows) was used to analyse the older people's use of oral health services from the 2012 OPOHS data-set .

Results:
Part 1: Clinical audit
Among the 203 identified patients (in the 8-month clinical audit), there was a male-to-female ratio of almost 3:2, and 90% were of European origin. Overall, 80% of the patients were living in their own homes; 80% were dentate. Some 30% presented with at least two medical conditions, and those living in a rest home had a higher mean number of medical conditions. General dental practitioners had referred more than 40% of patients in the 85+ age group whereas general medical practitioners (GP) had referred 33% in that age group. More than 50% of rest home patient referrals to the dental department were from their GP. Some 33% were oncology referrals (internal), while 33% were acute referrals and 60% had presented for elective dental treatment. Swollen face, odontogenic infection and irreversible pulpitis were the most likely reasons for acute referrals. Around 10% of patients had teeth extracted. Two-thirds of patients were referred to their general dental practitioner for follow-up.

Part 2: econdary analysis of 2012 NZOPOHS data
More than half of the overall study population were edentulous. The proportion of edentulous participants was higher in the RC population than the HB group. Overall, twice as many residents living in their own homes than those in the RC population had visited a dentist in private practice, with dental check-up being the main reason for visit. Likewise, 30% of the participants received a dental clean and similar proportion also had their teeth filled. Around 20% of the participants had a dental extraction. A higher proportion of residents from HB category than those in the RC population also visited a DHB dental clinic and a dental technician. On the other hand, at least three in four residents from the residential care population (dentate and edentulous) had not visited a dentist in the previous 12 months. Lack of perceived need and cost were reported as the two main reasons not visiting a dental professional in the past 12 months. Almost one in three participants from both the HB and RC facility reported "Moderate" or "A lot of difficulty" in paying a $150.00 dental bill. On the other hand, 25% of the Residential-care participants reported travel distance as the main reason for not seeking dental care in the past 12 months.

Conclusion: Around 25 older patients per month are referred to the waikato hospital dental department, for care from diverse referral sources, and the proportion of acute referrals is relatively high, suggesting that poor oral health among older adults is an important problem. Those living in residential care are unable to access professional dental care as easily as those in their own homes. Lack of perceived need, costs of the dental treatment and travel distance are reported as the major reasons for not visiting a dental professional. These findings show that older people presenting at hospital dental clinics have oral health needs and dental treatment needs that require urgent attention. Their inability to access dental care raises serious concerns about their oral health.

Huda Mohammed

Mohammed, H. H. (2019). Bond strength of a direct composite resin to resin-matrix ceramic materials with four surface treatments.

http://hdl.handle.net/10523/9794

Aesthetic demands have popularized the use of dental ceramic and indirect composite resin materials in modern dentistry. The introduction of dental CAD/CAM technology expanded the use of these materials even further. Furthermore, continuous advancements in CAD/CAM technology not only made a production of high-quality single visit indirect restoration possible, but also allowed for the use of high strength ceramics when required. This has made CAD/CAM produced restorations an attractive treatment modality for both the clinician and the patient and encouraged the dental materials manufacturers to produce various ceramic and composite CAD/CAM blocks to utilize this technology. However, both ceramic and composite materials being brittle in nature, are prone to catastrophic failure. It was suggested that amalgamation of the crystalline matrix and the polymeric material results in an increase in strength. Resin-ceramic materials, therefore, were developed and promoted on the bases of combining the positive features of both ceramic and composite resin material, however, clinical fractures might still occur.

Intraoral repair for localized restoration fracture could be a more conservative and cost-effective alternative to complete restoration replacement. Different repair treatment approaches for chipped/fractured restorations have been described in the literature for both dental ceramic and composite materials. Resin-matrix ceramic (RMC) materials are a relatively new group of CAD/CAM material, therefore, have not yet been well researched. Proper repair protocols for these materials also still have not been established. Various surface preparation techniques are described in the literature to facilitate bonding between two dental materials. Surface roughening procedures were evaluated and described by researchers to enhance the bond strength of composite resin repair to both ceramic and composite materials. The effect of surface roughening on various RMCs, however, is still not clear. Furthermore, the benefit of different surface roughening techniques on the bond strength of

composite resin repair to RMC materials is also to be determined. In addition, the few available in vitro studies that investigated this matter used bond strength testing methods which focused on evaluating the maximum stress at failure rather than the fracture energy needed to cause spontaneous crack propagation.

Aims: To evaluate the changes in surface morphology of commercially available RMC materials following different surface treatment methods; and to evaluate the bond strength of composite resin to different CAD/CAM RMC materials following different surface treatment methods using a three-point bend fracture toughness test method.

Methods: The surface of four RMC blocks (18 mm × 14 mm × 12 mm) - Vita Enamic (Vita Zahnfabrick, Bad Säckingen, Germany), Lava Ultimate (3M ESPE, St. Paul, MN, USA), Cerasmart (GC Dental Products, Kasugai, Aichi, Japan) and Shofu Block HC (Shofu INC., Kyoto, Japan) - were divided into four sections and subjected to four surface treatments: grinding only (G); grinding + 4.5% hydrofluoric acid (GF); grinding + airborne-particle abrasion using 50 µm aluminium oxide + 4.5% hydrofluoric acid (GBF); grinding + airborne-particle abrasion 50 µm aluminium oxide + 37% phosphoric acid (GBP). The resultant surfaces were then characterised using scanning electron microscopy.

A total of 240 beams shaped specimens (5 mm × 5 mm × 17 mm) were prepared from four types of CAD/CAM RMCs, Vita Enamic (VE), Lava Ultimate (LU), Cerasmart (CS) and Shofu Block HC (SB). Sixty beam specimens were prepared for each material and then subdivided into four groups (n=15) according to the surface treatment method, group G: grinding only; group GF: grinding + 4.5% hydrofluoric acid; group GBF: grinding + airborne-particle abrasion using 50 µm aluminium oxide + 4.5% hydrofluoric acid; group GBP: grinding + airborne-particle abrasion 50 µm aluminium oxide + 37% phosphoric acid. A nanocomposite material was packed onto the treated surfaces following the application of universal adhesive material according to manufacturers' instructions. The bond strength was tested using a fracture toughness 3-point bend test. Specimens were examined under scanning electron microscopy to determine the mode of failure. Data for groups CS and SB were analysed using a one-way ANOVA to evaluate statistical significance ($P<0.05$) while groups VE and LU, which showed non-parametric data, were analysed using a Kruskal Wallis test.

Results: Grinding followed by airborne abrasion produced greater changes in surface morphology of RMCs than grinding alone. Phosphoric acid had no effect apart from surface cleaning. Hydrofluoric acid produced porosity/ holes on the surface. Hydrofluoric acid effect was more pronounced in Vita Enamic when compared with Lave Ultimate and Cerasmart. Shofu blocks HC was the least affected by hydrofluoric acid.

Statistical analysis showed a significant difference between the different surface treatment within groups VE, CS and SB ($P< 0.05$). LU groups showed no interaction between surface treatment method and bond strength ($P= 0.629$). VE-G group showed statistically higher bond strength than LU-G, CS- GSBP and SB- GSBF.

Conclusions: All surface treatments showed alteration in the surface morphology of RMCs with hydrofluoric acid producing the greatest effect. The etching response was dependent on the size and elemental content of filler particles. No single surface treatment method can be generalized for all RMC materials to achieve a reliable bond strength. The process of sequentially increasing the surface roughness of the RMC materials via grinding, air-borne abrasion, hydrofluoric acid etching or combination of these methods produced an increase in the surface area available for bonding. However, this did not necessarily result in an increase in bond strength.

Nurulhuda Mohd Thiyahuddin

Mohd Thiyahuddin, N. (2019). Yeast Species in the Oral Cavities of Older People.

http://hdl.handle.net/10523/9695

Oral candidiasis is prevalent among older people due to predisposing factors such as impaired immune defences, medications and denture use. An increasing number of older people live in rest home facilities and it is unclear how this institutionalised living affects the quantity and type of fungi colonizing these people's oral cavities. Smears and swabs of the palate and tongue, and saliva samples were taken from participants residing in rest homes (RH; n = 25) and older people living in their own homes (OH; n = 25). Yeast in samples were quantified and presumptively identified by culturing on CHROMagar Candida agar. Sequencing of the ITS2 region of rDNA was carried out to confirm yeast species. Multilocus sequence typing (MLST) of 7 housekeeping genes was used to compare Candida albicans strains. A higher proportion of RH residents had Candida hyphae present in smears compared to OH participants (35% vs. 30%) although this difference was not statistically significant ($p = 0.74$). RH residents had, on average, 23 times as many yeast per mL saliva as OH participants ($p = 0.01$). C. albicans and C. glabrata were the most common species isolated from both participant groups. All C. albicans strains were similar within the same participant but very different between participants. Nine strains, found in 4 rest home participants, appeared to be C. albicans/Candida dubliniensis chimeras (hybrid strains). The results indicate that communal living for those who reside in an age care facility has an impact on the abundance of yeast species and the prevalence of chimera strains. This may be due to morbidities which led to the need for residential care and/or related to the rest home environment.

Emma Morelli

Morelli, E. L. (2019). Is parity associated with periodontal disease and other oral conditions? A longitudinal study.

http://hdl.handle.net/10523/9702

Many believe women's oral health deteriorates as a result of having children. This research aimed to investigate whether social and behavioural risk factors common to

both parity (number of times a woman has given birth) and dental disease (periodontal attachment loss (AL), and caries) may account for any association between oral health and parity.

Methods: The Dunedin Multidisciplinary Health and Development study is a longitudinal study of 1037 individuals (48.4% female) born from April 1972 to March 1973 in Dunedin, New Zealand. Logistic and negative binomial regression models were used to examine associations between the number of children born to female participants and their periodontal AL, dental caries experience, and tooth loss. Models controlled for confounders, including educational achievement, oral hygiene, dental service use and smoking.

Results: Data were available for 433 women (96.4% dentally assessed, aged 45). Of these, 76.2% had given birth to one or more children. Low educational attainment was significantly associated with having more children at all ages assessed. Parity by age 38 was not associated with periodontal AL, untreated dental caries, or prevalence of missing at least one tooth, but was associated with mean tooth loss and DMFS. Women who had children by age 26 experienced poorer dental health outcomes by age 45 than nulliparous women, or women entering motherhood later in life. Parity by age 26 was associated with the number of tooth surfaces with untreated caries at age 45 (IRR 1.69, 95% CI 1.22-2.35) and teeth missing due to caries (IRR 1.62, 95% CI 1.27- 2.08).

Conclusion: The biological effects of pregnancy appear less important for the development of dental disease than the social factors associated with having children. Level of education attained appeared to influence both a woman's reproductive patterns and health behaviours, which may in turn influence the risk of dental disease and how it is managed.

Saeideh Nobakht

Nobakht, S. (2020). Pleiotrophin family gene and protein expression in a sheep tooth socket model of bone healing.

http://hdl.handle.net/10523/10575

Resorption of alveolar bone after tooth extraction is a common problem. Bone replacement materials are used to enhance socket healing and reduce alveolar bone loss. The success of the graft is dependent on multiple factors including the presence of growth factors. This is the first in vivo study to investigate the expression of the pleiotrophin family of cytokines in association with a grafting material during bone regeneration.

Objective: To investigate the role of the growth factor family of pleiotrophin/midkine and their receptors, during osteogenesis with and without a grafting material, after tooth extraction in a sheep model.

Methods: Thirty Romney-cross ewes were anaesthetised and all premolar teeth on the right side were extracted. The sockets were randomised to controls sites with no treatment and test sites with Bio-Oss® graft material and Bio-Gide® membrane. Samples were harvested after sacrificing animals 4, 8, and 16 weeks post-grafting (n=10 per time-point). Tissue for qRT2-PCR gene analysis was recovered from the socket next to the first molar using a trephine (Ø=2mm). Each socket was fixed, decalcified, paraffin-embedded and sectioned. Immunohistochemistry (IHC) was conducted to localise pleiotrophin and midkine and their receptors anaplastic lymphoma kinase (ALK), receptor-type tyrosine-protein phosphatase zeta (RPTPζ) and notch-2.

Results: Within the healing sockets high expression of genes for pleiotrophin, midkine, notch-2, and ALK were found at all time-points and in both grafted and non-grafted sites, while RPTPζ was only expressed at low levels. The relative gene expression of the PTN family of cytokines were not statistically different at the three time-points and between test and control groups ($p>0.05$). Immunohistochemistry found pleiotrophin and midkine in association with new bone, notch-2 in the connective tissue and intranuclear localisation of RPTPζ and ALK in association with cuboidal osteoblasts involved in bone formation.

Conclusions: The pleiotrophin family was expressed in both non-grafted and grafted sockets during osteogenesis in a sheep model of alveolar bone regeneration. The discovery of the pleiotrophin/midkine family as important during alveolar bone regeneration is novel and opens up new avenues of research. Growth factor supplementation with pleiotrophin and/or midkine during healing may be an approach for enhanced regeneration or to initiate healing where delayed. The activation of notch-2 and RPTPζ may be important to bone regeneration in vivo.

Simon Olliver

Olliver, S. J. (2019). Long-Term Association of Occlusal Features with Temporomandibular Joint Sounds and the Incisor Relationship.

http://hdl.handle.net/10523/9689

Introduction: It has been suggested that certain features of occlusion that lay outside what is considered 'normal' have the potential to affect risk for temporomandibular joint disorders and incisor stability. This concept is highly controversial within the dental literature and previous research findings on associations are inconsistent.

Objectives: The research objectives were to a) investigate the association of commonly cited occlusal features during adolescence and temporomandibular joint clicking at age 45, and b) explore the changes that occur to the incisor relationship from adolescence to age 45.

Materials and Methods: The sample used were members of the Dunedin Multidisciplinary Health and Development Study (DMHDS), a longitudinal birth cohort study investigation of 1,037 children (48.4% female) born at Queen Mary Hospital, Dunedin, New Zealand between 1 April 1972 and 31 March 1973. For a) associations between specific putative occlusal risk factors (posterior cross-bite, overbite and overjet) at age 15, and TMJ outcomes (both self-reported and clinically assessed) at age 45 were studied. For b) changes in overjet

and overbite values were observed by grouping these individuals into low, normal and high categories at age 15, which were then compared to age 45 measures.

Results: The presence of posterior cross-bite, or abnormal overjet/overbite values during adolescence were not associated with TMJ clicking at age 45. Associations were found between self-reported history of tooth clenching and personality characteristics appear to be associated with self-reported clicking of the TMJ later in life. Additionally, there is a suggestion that high overbite during adolescence is associated with less risk for TMJ clicking later in life. Self-reported history of orthodontic treatment was not associated with TMJ outcomes.

For incisor relationship changes, mean overjet values were 0.5 mm higher, and mean overbite values were 0.5 mm lower at age 45 than at age 15. Regression modelling showed that overjet/overbite category (high or low) at age 15 tends to predict overjet/overbite category at age 45. Study members who self-reported tooth clenching had 0.3 mm more overbite at age 45 than those who did not self-report the habit. Additionally, those with signs of periodontal disease (5 + mm attachment loss) at age 38 had 0.5 mm more overjet at age 45 than those without disease. Sex differences were demonstrated with females having 0.6 mm more overjet and 0.4 mm overbite at age 45.

Conclusions: The findings suggest that common occlusal featuresin adolescence are not associated with higher prevalence of TMJ clicking later in life. Personality appears to influence self-reports of signs and symptoms of TMD, which may need to be considered in future research. The findings do not support the provision of orthodontic treatmentto reduce signs and symptoms of TMD later in life. The findings also indicate that overall overjet values tend to be higher during mid-adulthood than during adolescence, while the converse is true for overbite. There appears to be a degree of sexual dimorphism in overjet and overbite values later in life.

Arunadevi Ramasamy

Ramasamy, A. (2019). Perceptions of Special Needs Dentistry Amongst General Dentists in New Zealand.

http://hdl.handle.net/10523/9746

Aims: To describe the current perceptions of Special Needs Dentistry (SND) among general dentists in New Zealand; and, to define the role of the general dentist in the care of patients with special needs.

Methods: All general dental practitioners in New Zealand were invited to complete an online survey. All general dentists registered with the Dental Council New Zealand were included. The exclusion criterion were Special Needs dentists and specialists. An analysis of the data was performed using the SPSS for Windows version 25.

Results: Findings were that 82.8% of the respondents have treated people with special needs, but only 7.7% of general dentists reported they were very confident in treating people with special needs. New Zealand general dentists who had undergraduate dental training with an SND component comprised 49.2% of respondents. Lack of experience in treating people with special needs was found to be the biggest barrier to care for those general dentists who did not treat people with special needs.

Conclusion: This study is the first to report on perceptions of SND amongst general dentists in New Zealand. Results can be used to inform improvements to how SND is taught in New Zealand. Initiatives to encourage more general dentists to develop an interest in SND and have a positive attitude towards SND would be beneficial to the community, hospitals, government authorities, and policy makers. Such initiatives would lead to improvements in oral health care delivery for people with special needs.

Lucy Sullivan

Sullivan, L. (2019). The influence of educational information on understanding and perceptions of root canal treatment.

http://hdl.handle.net/10523/9706

Patients frequently have a negative perception of root canal treatment (RCT) often due to a lack of understanding and knowledge of what the treatment involves. This may lead to patients being more anxious and fearful of their RCT. This can result in discomfort, dissatisfaction, and an increased rate of appointment cancellation or failures, or restorable teeth being extracted. Information is lacking about how patient education affects patient understanding, experience and overall perception of RCT. Research in other fields of healthcare has shown the benefit of patient education in aiding the informed consent process and enabling patients to be more accepting of their treatment, increasing understanding of treatment and decreasing anxiety. If patients are more aware of what to expect during RCT, it is anticipated that treatment would be less intimidating, perceived more positively, enabling patients to feel more informed to provide consent and less anxious throughout their treatment.

This Practice Based Research study used a mixed-methods scientific approach and had three aims. The first aim was to develop and compare educational material on RCT in written and website form with existing written material. The second aim was to determine if delivering enhanced education to patients prior to treatment influences anxiety, understanding and perception of the procedure. The third aim was to gain an understanding of the current methods used by general dental practitioners (GDPs) to provide patient education and obtain informed consent prior to RCT and to seek their feedback on the enhanced educational material for RCT.

In New Zealand (NZ), dental practitioners have access to an information sheet on RCT, produced by the New Zealand Dental Association (NZDA). In this study, a more detailed educational pamphlet and website were developed. Participants who required RCT were recruited by their GDP in private practices throughout NZ. Participants received a standardised verbal description of the treatment sequence from their dentist and were randomly assigned to one of three educational information groups: 1) the NZDA pamphlet (n=23),

2) the new pamphlet (n=21), or 3) an electronic link to a website which contained the same information as the new pamphlet (n=17). Patients completed a questionnaire before and after treatment which collected data on themes, dental pain, knowledge of RCT, anxiety, educational material, understanding and perception of RCT. Data was analysed using descriptive statistics and thematic analysis. General dental practitioners were also interviewed to provide feedback on RCT education and to understand their process of obtaining informed consent.

An insight into the perceptions and understanding of RCT of a group of patients in NZ was obtained. Prior to commencing RCT, 42.6% of participants reported feeling anxious about having the treatment. Over one third (39%) of the participants felt anxious prior to attending the dentist. Patients found the new pamphlet and website informative and easy to understand. Over half (59.6%) of the participants felt that they had increased knowledge about RCT after education and treatment. The presentation of educational material prior to treatment increases understanding and lowers their anxiety and improves perception of treatment and meant they could more confidently make an informed decision and feel more positive about RCT.

General dental practitioners interviewed all placed great importance on having an in-depth shared discussion of treatment with their patients prior to commencing RCT and obtaining verbal consent. Written consent is not routinely gained by the GDPs. The GDPs preferred the enhanced educational material to the existing NZDA pamphlet as it was more clear and comprehensive.

The outcomes from this study, can be translated to clinical practice. It is crucial that GDPs understand that anxiety is often felt by patients prior to RCT and patients do not always present with a knowledge of treatment. The provision of enhanced educational material facilitates the informed consent process and improves the patient experience.

Elizabeth Tauati-Williams

Tauati-Williams, E. P. (2019). Investigation of the presence of Human Papillomavirus in verrucal-papillary lesions of the oral cavity and comparison of viral detection methods.

http://hdl.handle.net/10523/9628

Background: The human papillomaviruses (HPVs) are known to induce cutaneous and mucosal proliferation of epithelial cells. HPVs are classified into low-risk (LR) and high-risk (HR) types, depending on their association with the development of benign, potentially malignant or malignant lesions. Oral verrucal-papillary lesions (OVPL) are a distinct spectrum of epithelial lesions affecting the oral mucosa from benign to malignant: some are thought to be associated with HPV. The HR-HPV types have been implicated as causative agents in the development of some head and neck squamous cell carcinomas (HNSCC) and cervical cancer. However, the role of HPVs in the pathogenesis of OVPLs and their transformation to oral squamous cell carcinoma (OSCC) is uncertain.

Objective: To determine the expression of HPV and other HPV-related proteins and quantify HPV nucleic acids (DNA) in OVPLs and OSCC using immunohistochemistry (IHC), in-situ hybridisation (ISH) and quantitative real time polymerase chain reaction (qRT-PCR) detection methods and to compare the sensitivity and specificity of the HPV detection techniques.

Methods: Forty-one archival formalin-fixed paraffin-embedded (FFPE) tissue samples were obtained and grouped into four specific histopathologically confirmed groups of OVPLs and related lesions. For pan-HPV and p16 IHC the groups were as follows; squamous papilloma (SP; n=10), verrucous hyperplasia (VH; n=15), verrucous carcinoma (VC; n=6) and oral squamous cell carcinoma (OSCC; n=10). Cervical carcinoma tissue samples were used as positive controls (n=2) for validation. Qualitative assessment of the distribution and pattern of staining for both pan-HPV and p16 antibodies were carried out using light microscopy at various magnifications. p16 quantitative assessment of digitised IHC images (400x magnification) using Image J software to examine the extent of positive reaction, intensity of staining and determine immune-reactive score for all experimental tissue samples was also undertaken. One-way ANOVA tests in the Prism GraphPad 7 for Mac OS X (GraphPad Software, Inc, USA) and a Sidak's multiple comparisons test also within the ANOVA, was used to analyse the difference in the expression between the experimental test groups. P values of <0.05 were considered to be statistically significance between the experimental groups.

A trial run using both HR and LR ISH probes with a Ventana ISH system in conjunction with an iView detection kit and a Leica ISH system for probing for HR-HPV DNA on the cervical cancer positive control was undertaken. For qRT-PCR, extraction of DNA was conducted on all 43 FFPE tissue blocks including the two positive control tissue samples using GeneJET FFPE DNA Purification Kit (#K0881, Thermo ScientificTM Life Technologies, New Zealand Limited). The quality of DNA, was measured by A260/A280 ratio, ideally should be >1.7. However, from the trial experiment, a quality threshold value of 1.6 was determined. Quantification and detection of high-risk HPV (HR-HPV) (12 types, 16 and 18) DNA was carried out using qRT-PCR TaqMan assays.

Result: HPV and other related proteins were differentially expressed amongst the OVPLs and OSCC. Pan-HPV proteins were highly expressed in all tissue samples pertaining to the OVPLS and OSCC experimental groups. p16 protein was underexpressed in the aforementioned groups and only one tissue sample pertaining to the VC group was p16-positive. A statistically significant proportion of score (PS) ($p < 0.05$) in a sample pertaining to the SP group when compared to OSCC was also noted. With the Ventana ISH system no positive results were obtained with the 'positive' control, despite several trouble-shooting exercises. Positive brown punctated staining for HR-HPV types 16,18,31,33 and 51 using Leica Biosystem (DNA) probes was observed within nuclei of some malignant cervical epithelial cells, but due to technical difficulties the full experimental run could not be completed. HR-HPV DNA (16, 18 and 12 types) was not detected in any of the OVPL FFPE tissue specimens using qRT-PCR. However, HR-HPV (12 types) DNA was detected in the internal controls as well as both positive control cervical tissue samples.

Conclusion: Pan-HPV proteins (1, 6, 11, 16, 18 and 31) were highly expressed in OVPLs and OSCC samples. The overexpression of pan-HPV proteins may be due to the fact that only LR-HPV are associated with these lesions. p16 protein was underexpressed amongst the OVPLs and OSCC samples. Hence, in this study, there was no evidence to suggest that p16 was a useful surrogate marker for HR-HPV infection in OVPLs and OSCC. Using qRT-PCR HR-HPV types 16 and 18 were not detected in any of the OVPL and OSCC experimental samples nor in the positive control samples used. There was no evidence to suggest that HPV types 16 and 18 play an oncogenic role in the pathogenesis of OSCC. The other 12 HR-HPV types (31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68) were quantified and detected in the cervical (positive control) tissue samples. The rest of the tested group samples showed negative results. qRT-PCR is more sensitive and specific when compared to IHC and must be considered to be the first initial HPV detection method.

Tatiana Tkatchenko

Tkatchenko, T. (2020). Radiographic and histomorphometric evaluation of an ovine forestomach matrix combined with Bio-Oss bone graft in a sheep tooth extraction model.

http://hdl.handle.net/10523/10572

Background: Alveolar ridge is a tooth dependent structure. Following tooth extraction, volume reduction and dimensional changes take place. These changes often make it difficult to replace the missing teeth due to a lack of bony support and compromised aesthetics. To minimise and overcome these issues various alveolar ridge preservation techniques (ARP) have been developed. One of the more commonly used techniques is treatment with bone replacement graft material (BRG) covered by a barrier membrane. One of the more frequently used BRG materials in Australasia is Bio-Oss® (Geislich, Switzerland) in combination with Bio-Gide® (Geistlich, Switzerland) membrane. This project sought to compare established membrane Bio-Gide® to Ovine Forestomach Matrix (OFM, Aroa Biosurgery Limited, New Zealand).

Objectives: To conduct a systematic review and assess the existing evidence for outcomes of bone xenograft in combination with resorbable collagen membranes for alveolar ridge preservation in randomised clinical trials in non-human and human experimental models. To analyse healing outcomes and compare OFM to Bio-Gide® in a pre-clinical and histological equivalency trial; and to test non-inferiority between these two membranes.

Materials and methods: Thirty sheep underwent the extraction of three left mandibular premolars. Using Latin-square allocation three treatment groups were assigned. Treatment A (OFM + Bio-Oss®), treatment B (Bio-Gide® + Bio-Oss®, positive control) and treatment C (naturally healed socket, negative control). Ten animals were allocated to each of three healing time points of 4-, 8- and 16-weeks. After the allocated healing time the animals were euthanised, mandibles dissected, and extraction sockets resin embedded for descriptive histology, radiographic and histomorphometric analysis.

Results: At four weeks, all sockets mostly comprised connective tissue. The sites grafted with BRG, regardless of membrane used, showed small projections of woven bone that extended towards the lumen of the socket and surrounded the Bio-Oss® particles. At eight weeks, the control sockets were still predominantly filled with connective tissue, while sockets with BRG formed a hard tissue bridge composed of woven bone between the buccal and lingual cortical plates. At 16-weeks of healing, complete bridging between socket margins was evident in all three groups. Histomorphometric analysis demonstrated significant new bone increase over time in OFM group ($p<0.009$). At 4-weeks the Bio-Gide® group had more residual bone graft compared to the OFM group, 13.92±10.64% and 5.45±6.59% respectively ($p=0.005$). However, this difference was not observed at 8- or 16-weeks. Both grafted groups have significantly less connective tissue compared to the ungrafted control group at 4-weeks ($p<0.045$). Radiographic and histology images of the same sites were matched well.

Conclusion: This study found that OFM demonstrated equivalent outcomes to Bio-Gide® membrane in terms of graft retention and osteogenesis in an ovine tooth extraction model.

Oripa Waqa

Waqa, O. A. (2019). BRAF mutations in ameloblastoma: Correlation with clinical and histopathological features and behaviour.

http://hdl.handle.net/10523/9790

The invasive nature of ameloblastoma necessitates tumour-free surgical margins to minimise recurrence and thereby ensure improved prognosis. The vast majority of ameloblastomas originate centrally, and surgical management results in significant loss of affected structure, and therefore often requires extensive reconstruction. Recently, it has been shown that the mitogen activated protein kinase (MAPK) pathway plays an important role in the pathogenesis of ameloblastoma. B-Rapidly Accelerated Fibrosarcoma gene (BRAF, also known as B-Raf proto-oncogene, serine/threonine kinase) (HGNC:1097) is essential in the MAPK pathway physiology. Mutation involving BRAF V600E has been demonstrated in melanoma as well as in ameloblastoma. Although BRAF mutation has been shown in ameloblastoma, its implications relating to tumour stromal angiogenesis and proliferation remains elusive. This study aimed to assess the expression of BRAF V600E mutation in ameloblastoma using immunohistochemistry (IHC) and the correlation of the findings of these results with stromal vascularity and lesional proliferation. The results were then contextualized in relation to clinico-pathologic parameters.

Aim of the study: The aim of this project was to profile BRAF mutation in ameloblastoma and to correlate this with clinical and histological parameters and patient outcomes.

Objectives: Firstly, to assess the expression of BRAF V600E mutation by means of IHC in tissue sections

derived from cases of ameloblastoma. Secondly, and to correlate these results with stromal tissue vascularity determining the micro-vessel density (MVD) using CD34 and lesional proliferation using Ki-67. Finally, to correlate the presence of the mutant protein to the clinic-pathologic parameters.

Materials and Methods: Formalin-fixed paraffin-embedded samples of ameloblastoma were retrieved. These samples were stained with antibodies against BRAF V600E (Ventana; 06918727001), Ki67 (Ventana; 05278384001) and CD34 (Ventana; 05278210001). The immunoglobulin G (IgG) isotype was used for negative control. Hotspot locations in the epithelium and connective tissue (n=3 each) from each specimen were photomicrographed and semi-quantitatively analysed for the intensity score while the proportion score was assessed qualitatively through the use of ImageJ plugin. Intensity and proportion scores were used to calculate the immunoreactive score (IRS). The microvessel density (MVD) and the proliferative index (PI) was assessed through the use of the ImageJ plugin gridlines over the hot spot areas that had been photomicrographed and the micro-vessels were then counted with the cell counter. Clinico-pathologic data was entered into an Excel spread sheet and data analysis using Fisher's Exact and Pearsons tests were performed in GraphPad PRISM software. The p-value of less than 0.05 ($p < 0.05$) denoting statistical significance was referenced.

Results: A total sample of 44 ameloblastoma cases were included in this study. Most of the samples were predominately of the follicular pattern of ameloblastoma (59.1%) with a smaller proportion of lesions showing plexiform histological patterns (29.5%). The mean age at diagnosis was 36 years (range of 10-73). The male to female ratio was 1.2: 1 with 89% of the cases affecting the mandible. The neoplastic epithelium in 93% of cases was BRAF positive (BRAF+) and 27% of these displayed high reactivity (IRS>5). 81.8% of mandibular lesions were BRAF+. CD34 MVD and Ki-67 PI corresponded with higher BRAF reactivity. There was an independent statistically significant association observed between the expressed mutant protein and the recurrence of ameloblastoma. A significant association between ameloblastoma recurrence together with higher MVD and PI was also observed.

Nurul Izyan Zainuddin

Zainuddin, N. I. (2019). Neuropilin-1 expression in the tumour microenvironment of oral squamous cell carcinoma.
http://hdl.handle.net/10523/9789

Background: Neuropilin-1 (Nrp-1) is a transmembrane glycoprotein involved in multiple biologic and pathologic processes including carcinogenesis. It is widely expressed in cancers where it has been correlated with poorer prognosis. Nevertheless its expression profiles and significance in oral squamous cell carcinoma (OSCC) remain elusive.

Objective: To investigate the expression of Nrp-1 in OSCC and oral epithelial dysplasia (OED) using immunohistochemistry (IHC), and to examine its co-localisation with markers for angiogenesis and T regulatory cell (Tregs), namely vascular endothelial growth factors 2 (VEGFR2) and forkhead box P3 (FoxP3) respectively, using double-labelling immunofluorescence (DLIF).

Method: Formalin-fixed paraffin-embedded (FFPE) blocks were obtained from the archives of the Oral Pathology Centre, University of Otago. These specimens were divided into three groups namely OSCC, OED and non-specifically inflamed mucosa (NIM). The samples from these groups comprised well-differentiated OSCC (n=21) and moderately-differentiated OSCC (n=2), low-risk OED (n=8) and high-risk OED (n= 9), and NIM (n= 14). Immunohistochemistry was performed with an antibody against Nrp-1. Hotspot locations in the epithelium and connective tissue (n=3 each) from each specimen were photographed and analysed semi-quantitatively. Kruskal-Wallis tests were performed with $p<0.05$ denoting significance. Intensity and proportion scores were used to calculate the immunoreactive score (IRS). DLIF results were qualitatively examined to determine the co-localisation of Nrp-1 with VEGFR2 and FoxP3.

Results: The OED epithelium showed significantly higher expression of Nrp-1 than NIM and OSCC ($p=0.04$). No other significant quantitative differences were observed in the epithelium or connective tissue between the groups. Qualitatively Nrp-1 was more highly expressed on the stromal cells in OSCC and OED tissues than in NIM. Nrp-1+/FoxP3+ co-localisation showed a similar pattern of co-localisation in OED and OSCC where Nrp-1 was present on the surface of FoxP3+ cells. Nrp-1+/FoxP3+ co-localisation was also present in NIM samples but here it showed nuclear co-expression. There was no evidence of Nrp-1+/VEGFR2+ co-localisation in OSCC and NIM samples but it was detected in stromal cells of OED samples.

Conclusion: The epithelial overexpression of Nrp-1 in OED suggests that it may be important in the initial dysplastic transformation, but not necessarily in progression once malignant transformation has occured. The high Nrp-1 expression on variable stromal cells in OED and OSCC demonstrates that Nrp-1 is likely to play a significant and diverse role in immune function and regulation via its wide-ranging interactions in the human immune system. The Nrp-1+/FoxP3+ co-localisation on stromal mononuclear cells in OED and OSCC suggests that Nrp-1 may modulate the microenvironment to make it conducive to disease progression, while the variability in the co-expression patterns may indicate the ability of Nrp-1 to differentiate Tregs subsets. VEGFR2 does not appear to be a meaningful co-receptor for Nrp-1 in OSCC and thus Nrp-1-associated angiogenesis may involve alternative mechanisms.

Further research may show the potential of Nrp-1 as a novel prognostic and therapeutic marker in OSCC potentially through the mechanism of immune regulation. A more detailed study is required to further elucidate the role of Nrp-1 in cancer angiogenesis.

Postgraduate degree completions

Master of Community Dentistry (MComDent) completions, 2019-2020

Student	Advisors (Primary listed first)	Thesis title	Graduated
Hayley Dixon	Prof Murray Thomson Mr Graeme Ting	Oral Health Quality of Life instrument for head and neck cancer patients	Dec 2019
Alexander Holden	Prof Murray Thomson	Money where your mouth is: how do dentists manage conflicts between commercial pressures of practice and professional obligations?	Dec 2020
Helen Lloyd	Prof Murray Thomson Assoc Prof Mani Ekambaram Ms Dorothy Boyd	The use of child oral-health-related quality of life measures in a randomised control trial of the Hall crown technique in a primary care setting	Dec 2020
Kate Naysmith	Prof Murray Thomson Prof Darryl Tong	The oral health status of New Zealand Defence Force recruits and officer cadets	Dec 2020

Other Master's degree completions, 2019-2020

Student	Degree	Graduated
Keri Carruthers	Master of Oral Health (MOH)	Dec 2019
Naseem Asadi	Master of Oral Health (MOH)	Dec 2020
Ritu Ganjigatti	Master of Dentistry (MDent) endorsed in Aesthetic Dentistry	Dec 2019
Hansoo Bae	Master of Dentistry (MDent) endorsed in Rural Oral Health	Dec 2020
Shweta Gautam	Master of Dentistry (MDent) endorsed in Aesthetic Dentistry	Dec 2020
Neethu Rakesh	Master of Dentistry (MDent) endorsed in Aesthetic Dentistry	Dec 2020

Postgraduate Diploma (PGDip) completions, 2019-2020

PGDipCDTech Postgraduate Diploma in Clinical Dental Technology
PGDipComDent Postgraduate Diploma in Community Dentistry
PGDipClinDent Postgraduate Diploma in Clinical Dentistry

Student	Degree	Graduated
Kaitlyn Brailsford	PGDipCDTech	Dec 2019
Jung Eun Choi	PGDipCDTech	Dec 2019
Molly Clark	PGDipCDTech	Dec 2019
Alexandra Dempster	PGDipCDTech	Dec 2019
Sanghyung Do	PGDipCDTech	Dec 2019
Halgart Du Preez	PGDipCDTech	Dec 2019
Kendall Garrud	PGDipCDTech	Dec 2019
Felicity Hart	PGDipCDTech	Dec 2019
Wendy-Ann Jansen van Vuuren	PGDipCDTech	Dec 2019
Paul Jeftic	PGDipCDTech	Dec 2019
Kylie Jones	PGDipCDTech	Dec 2019
Ji Chul Kim	PGDipCDTech	Dec 2019
Ethan Liaw	PGDipCDTech	Dec 2019
Zichuan Lin	PGDipCDTech	Dec 2019

Student	Degree	Graduated
Kabelo Petlo	PGDipCDTech	Dec 2019
Claudia Rohani	PGDipCDTech	Dec 2019
Yelyzaveta Tykhonova	PGDipCDTech	Dec 2019
Caira Uy	PGDipCDTech	Dec 2019
Chen Yang	PGDipCDTech	Dec 2019
Wenzhao Cao	PGDipCDTech	Dec 2020
Jung-Woo Lee	PGDipCDTech	Dec 2020
Siyuan Li	PGDipCDTech	Dec 2020
Yingying Sun	PGDipCDTech	Dec 2020
Carlos Yeung	PGDipCDTech	Dec 2020
Weiyi Zhao	PGDipCDTech	Dec 2020
Chuen Lin Hong	PGDipComDent	Dec 2020

Student	Degree	Graduated
Kate McElroy	PGDipClinDent endorsed in Oral Pathology	Dec 2019
Thanushan Raviendran	PGDipClinDent endorsed in Oral Surgery	Dec 2019
Nigel Tan	PGDipClinDent endorsed in Oral Surgery	Dec 2019
Malosi Poma	PGDipClinDent endorsed in Periodontology	Aug 2019
Iarawoi Rezel	PGDipClinDent endorsed in General Practice for Dentistry	Dec 2020
Jenny Tangis	PGDipClinDent endorsed in General Practice for Dentistry	Dec 2020
Senthilkumar Vedagiri	PGDipClinDent endorsed in General Practice for Dentistry	Dec 2020
Joseph Foster	PGDipClinDent endorsed in Oral Surgery	Dec 2020
Yuxin Lin	PGDipClinDent endorsed in Oral Surgery	Dec 2020
Helen Campbell	PGDipClinDent endorsed in Paediatric Dentistry	Aug 2020
Hae Min Lee	PGDipClinDent endorsed in Paediatric Dentistry	Aug 2020
Lorraine Lim Park	PGDipClinDent endorsed in Paediatric Dentistry	Dec 2020