

Undergraduate Experience in Dental Research: the Bachelor of Science (Dentistry) Program at the University of Manitoba

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The faculty of dentistry at the University of Manitoba is charting new territory with the development of its undergraduate dental research experience. This program is one step in cultivating researcher-clinicians for the next era of dentistry. The current focus on training dental researcher-clinicians has its roots in the faculty's past. Outstanding research alumni include Dr. Israel Kleinberg and Dr. Lorne Golub, who, along with others in Canada and elsewhere, have established the fundamental requirement for credibility in basic dental and biomedical research. At the faculty, we believe that the present and the future of dentistry lie in how we instill in our students the desire for knowledge of the most unique kind — that generated in the simplest of settings, by oneself. Research can be regarded not only as the creation of knowledge, but also as a foundation for future endeavours. Thus, no matter how humble the research, its future potential is both unknown and unlimited. In this vein, we are developing a program for the future of dentistry, one in which students will come to recognize the interdependence of oral and systemic health, to the benefit of their patients.

In this article, I present 3 examples of groundbreaking research activities within the faculty, all involving undergraduate dental students who have undertaken original research as part of the Bachelor of Science (Dentistry) program. One particularly important feature of these activities is the broad spectrum of support that has been generated, the result being generous funding from various agencies, including the Heart and Stroke Foundation, the National Institutes of Health (United States), the Manitoba Institute of Child Health and the Canadian Institutes of Health Research (CIHR).

Interdisciplinary Research on Caries Detection

Among the numerous research activities within the faculty is a project involving an interdisciplinary team of scientists, engineers and clinicians who are developing novel methods for early detection and longitudinal monitoring of dental caries. The goal is to incorporate 2 optical methods, optical coherence tomography (OCT) and polarized Raman spectroscopy (PRS), into a single clinical probe to improve surveying of early white spot lesions (incipient caries). This research is led by scientists and engineers from the National Research Council's Institute for Biodiagnostics, located in Winnipeg, including Lin-P'ing Choo-Smith (principal investigator), Mark Hewko, Alex Ko and Mike Sowa. The faculty of dentistry is providing clinical cariology input (from William Wiltshire and Colin Dawes), and collects human tooth samples (through the efforts of Cecilia Dong). To develop the clinical probe, the team is collaborating with a group of optical and electronic engineers from the National Optics Institute (Quebec City), led by Patrice Topart. In 2004, this newly formed consortium received a grant from the National Institutes of Health – National Institute of Dental and Craniofacial Research to develop the probe and validate research developments in pre-clinical in vivo studies. This grant follows on previous grants from the Manitoba Medical Service Foundation and the CIHR – Institute for Musculoskeletal Health and Arthritis (IMHA).

A key element in the research activities on caries detection has been the participation of various undergraduate clinical students from the faculty and elsewhere. Through the faculty's BSc (Dent) program, Raymond Zhu has investigated the capacity of OCT and PRS



Amanda Huminicki, fourth-year student and proud first-place winner in the junior category of the 2007–2008 CADR–IMHA awards competition. The award was presented at the joint IADR–CADR annual meeting, Toronto, July 2008.

to monitor the longitudinal development of incipient caries using a pH cycling model for artificial caries. For this work, Raymond won first place in the CIHR-Network for Oral Research Training and Health (NORTH) e-conference presentation in 2006. Also through the BSc (Dent) program, Amanda Huminicki has been examining the effects of possible confounding factors (e.g., stain, calculus, hypocalcification) that might interfere with the use of this novel, high-sensitivity, high-specificity method. On the strength of this research, Amanda was awarded first place in the junior category of the 2007–2008 Canadian Association for Dental Research (CADR) – IMHA awards competition. Both of these students were funded through the CIHR-NORTH program, an initiative to expose undergraduate dental students to oral health research. This program also allowed Kamil Gibrayel, a student in the International Dentist Degree Program in our faculty, to use these optical methods to follow the repair of artificially induced caries by addition of fluoride to a circulating remineralization buffer solution. In addition, Nilava Ghatak, a student from the University of Toronto's faculty of dentistry, was funded by CIHR-NORTH to join the group in summer 2005 to develop methods for transverse microradio-

graphic analyses on histologically sectioned tooth samples. Transverse microradiography is the gold standard for quantifying mineralization and is therefore essential for comparing the results obtained with new optical methods and those obtained using standard methods.

Overall, this research requires collaboration among clinicians (and clinicians-in-training), scientists and engineers. Together, these researchers are developing relevant clinical tools that can be translated from the laboratory bench to the dental chairside.

Research on Pain Associated with Severe Early Childhood Caries

On another research front, Alex Serebnitski is working with Dr. Robert Schroth and Dr. Lynn Breau (Dalhousie University) to document pain among children with severe early childhood caries (S-ECC). S-ECC is a rampant form of primary tooth decay among children younger than 72 months of age. Little information about preschool dental pain is available. This pilot study has been undertaken to create and validate a tool to measure the pain experienced by preschoolers with S-ECC. A comprehensive review of both the pediatric pain and pediatric dental literatures generated a list of potential items for assessing pain, which were presented to parents in the form of a pilot questionnaire. The tool was designed to elicit parents' judgments of their child's behaviour over a single day. For the purposes of this project, S-ECC has been defined according to established criteria, and children and their parents or caregivers are being recruited from community and private practice clinics.

Review of Pediatric Dental Surgery

Under the supervision of Dr. Schroth and sponsored by the Manitoba Institute of Child Health, Jordan Pang is conducting a review of pediatric dental surgery in Manitoba. These investigators are using administrative data maintained by Manitoba Health and Manitoba Healthy Living, spanning the years 1997 to 2006. Children who underwent general anesthesia for dental surgery in Manitoba during this period are eligible for inclusion. Since ECC is age specific, the cohort is limited to children less than 72 months of age at the time of dental surgery. This project will provide historical information about pediatric dental surgery in Manitoba hospitals. More importantly, it will provide information for health policy decision-makers, which may be useful for predicting future demand for such services and for identi-

fyng some of the underlying issues that may need to be addressed. It will also assist those who are charged with promoting and improving the oral health of young Manitoba children by identifying populations of children with higher rates of general anesthesia for pediatric dental surgery.

Investigation of Platelet Activation by Oral Microorganisms

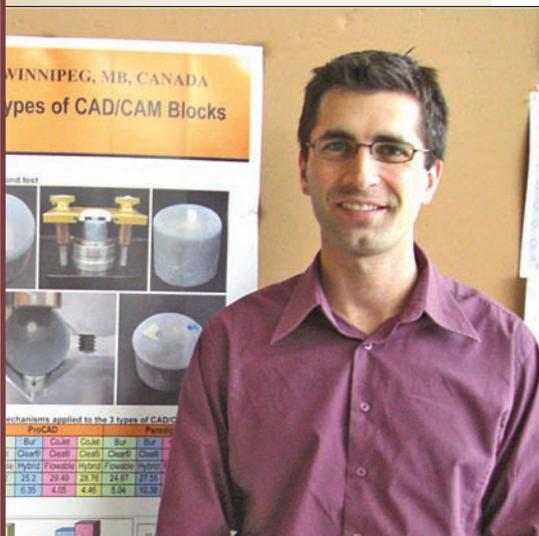
An example of more basic biomedical research in the faculty is the work of Alex Witzke, under the supervision of Dr. Archie McNicol: an investigation of platelet activation induced by oral microorganisms. Epidemiological evidence supports the hypothesis of a relationship between periodontal disease and cardiovascular disease, notably thrombosis. It has been hypothesized that bacteremias, which occur with greater frequency among individuals with periodontal disease, may contribute to the development or progression of cardiovascular disease. One potential mechanism is the direct activation of platelets by orally derived organisms. Previous laboratory studies have demonstrated that platelet aggregation in vitro (a model for thrombus formation in vivo) occurs in response to certain strains of *Streptococcus sanguis* by a mechanism requiring the presence of von Willebrand factor and immunoglobulin G in the plasma. Last summer, Alex demonstrated that certain strains of the periopathogen *Porphyromonas gingivalis* also stimulate platelet aggregation. Of

particular interest was his observation that more pathogenic strains of *P. gingivalis* elicited more robust platelet activation than that observed in response to less pathogenic strains.

These studies have all been carried out using single strains of either *S. sanguis* or *P. gingivalis*, which does not reflect the situation in vivo, where platelets are exposed to multiple organisms during bacteremia. Therefore, Alex is now using mixtures of sub-threshold levels *S. sanguis* and *P. gingivalis* to stimulate platelet aggregation. This “mix and match” approach will help address the possibility that platelet activation induced by microorganisms in vivo is not the result of any single organism but occurs as a result of total pathogenic load. Such conditions would occur, for example, during periodontitis, when multiple oral organisms can enter the circulation.

Conclusions

The projects described here are only 4 of 24 BSc (Dent) research programs currently under way in the faculty. The projects range from clinical orthodontic studies and assessments to examinations of in vitro cellular responses to lipopolysaccharide and extracts of cigarette smoke. For all projects, the student is required to prepare the work and defend it orally before a faculty oral forum. The ultimate expectation is that the research will be published as a scientific paper in the dental literature. Financial support for the students in this program comes from the Manitoba Medical Service Foundation, the Manitoba Institute of Child Health, the Manitoba Dental Association and the Aboriginal Capacity and Developmental Research Environments, in addition to faculty funds. The overriding goals of this program are to enhance the experience of dental students and to support the development of a DMD/PhD program at the faculty by providing research experiences at an early stage, an objective that has been recognized as important for many years. Finally, it is expected that these experiences will stimulate among these students a desire for further explorations, leading to their acquisition of graduate-level training and their development as the dental researchers of the future. ♦



Kristopher Coulter, fourth-year student and proud winner of the CIHR/Canadian Student Health Researcher national student poster competition and the Dean of Dentistry Award. The award was presented at the University of Manitoba National Health Research Day, Winnipeg, June 2008.

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