



Stimulus & Challenge

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# Research News

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## International Student Visitors

The Department of Applied Oral Sciences is pleased to welcome another research student visitor for the summer of 1995. These student visitors to the Department spend between 5 and 9 weeks working on an elective research project. Michael Dabb a third year dental Student at the University of Birmingham, England, will undertake a research elective in biomaterials at Dalhousie University. Mr. Dabb will join a list of 10 other students from four European universities who have conducted electives in biomaterials laboratory research at Dalhousie during the past seven years. The list includes the following.

Elfyn W. Samuel, from the University of Wales, Cardiff, UK.

Joseph Gamba, Duncan Black, Rhona Liston, Diedre Barrett, Sean Daley and Andrew Wright, from the University of Dundee.

Philip Tangri and Michael Dabb, from the University of Birmingham, UK.

Constant Durville and Ernst van der Jagt, from the University of Amsterdam, Netherlands.

The international reputation of biomaterials research at Dalhousie University has attracted students from Europe who see Dalhousie as a leader in the field of biomaterials research. These elective research programmes provide a most interesting learning experience for the

students. In addition to the research experience these European students also gain experience of the North American way of life and have opportunities to meet and work with students and exchange ideas and compare and contrast the Canadian and European dental programmes.

## Warner-Lambert Research Award for Vivian

In January 1995 Vivian Ke, (Third year DDS) was selected as the recipient of the Annual Warner-Lambert Award for her demonstrated aptitude in research. Vivian has been active in research at Dalhousie conducting research in biomaterials. The recommendation by the Research Development Committee will allow Vivian to attend the 31st Annual Dental Students Conference on Research. The meeting this year is being held at the National Institute of Dental Research, Bethesda, Maryland on March 25th-28th 1995. The basic objective of the conference is to expose outstanding dental students to dental educators, scientists and administrators and make them aware of the wide scope of careers available in dental research. The Council on Dental Research of the ADA sponsors the annual orientation programme on dental research for one dental student from each dental school in the United States, Canada and Puerto Rico. The

training and recruitment of graduate students is of paramount importance to the expansion and improvement of dental research. Vivian's aptitude, interest and record in research combined with her academic record made her an excellent choice to attend this meeting to represent Dalhousie University. A report of Vivian's experience at this interesting meeting will be published in the Dalhousie University Dental Students Journal.

## Students Participate in Top Research Meeting.

Three students were selected to attend the AADR/CADR international dental research meeting in San Antonio to present research papers based upon their summer research work. The international meeting held this month was expected to have an attendance of about 4,500 dental scientists with a total of 1,960 research papers being presented. The three lucky students were Katrina Sawler who had been working on a project with Dr. Chaytor and colleagues, Paul Miller who had been working on a project with Dr's Ismail, MacInnis and Pass and Paul Hurley who worked with Dr's Goodday and Precious. The students were funded by the Canadian Fund for Dental Education and corporate sponsors.

## Research Presentations

Dr. Barry Pass will present two papers at the 4th International Symposium on ESR Dosimetry and Applications, in Munich Germany in May 1995. The abstracts for these two papers are presented below and on page 3.

### **RADIOTHERAPY DOSES FOR TREATMENT OF INTRAORAL TUMORS RETROSPECTIVELY MEASURED BY ELECTRON SPIN RESONANCE IN DENTAL ENAMEL.**

B.Pass, R.Wood, P. Scallion and P. McLaughlin.

Previous studies have established electron spin resonance (ESR) in dental enamel as a reliable means of dosimetry for acute exposures to radiation sources external to the body. These studies were *in-vitro* as they used teeth extracted soon after exposure. The present study is an investigation into the use of ESR in dental enamel to achieve simultaneous *in-vivo* and in-beam dosimetry for fractionated radiotherapy of intra-oral tumors. Radiation produces free radicals in dental enamel that have an indefinite lifetime and whose number is proportional to the absorbed dose. ESR can be used to measure the absorption of electromagnetic (microwave) radiation by these free radicals. The magnitude of this absorption is proportional to the number of free radicals and thus gives a measure of absorbed dose.

In the present study, teeth were collected that had been extracted from patients subsequent to radiation therapy for intra-oral tumors and bone marrow transplants. The dental enamel was then separated in the form of coarse chips. ESR was then performed on these samples. A calibration ESR dose-response curve was established by performing ESR on dental enamel

samples that were irradiated to known doses using 1.25 MeV Cobalt-60 gamma-rays. Thus, all radiotherapy doses are given as Cobalt-60 equivalent doses.

Measurements of absorbed radiation dose for 10 teeth extracted from the general population and subsequently irradiated to known doses produced no discrepancies within the  $\pm 10\%$  experimental error for the ESR technique. Measurements of absorbed radiotherapy doses were made on 42 teeth from 19 patients. There was good agreement between the doses calculated by treatment planning and those determined by ESR in dental enamel for the 14 of the 42 teeth. Included in the study were teeth inside and outside the radiation treatment field. There were, however, up to order of magnitude discrepancies for the remaining 28 teeth.

Studies have shown that there is no ESR signal fade for *in-vitro* enamel samples. However, the effect of a delay between radiotherapy and extraction of the teeth, with a resultant signal fade for teeth *in-vivo*, has not been investigated. Other factors that may account for the above dose discrepancies are fractionation of the doses, field geometry, beam type, loss of energy at air-enamel interfaces, scatter radiation and lack of universal validity of the esr/dose calibration curve. The question of how accurately the position of a tooth in the field can be predicted from the isodose curves and check films must also be addressed.

The validity of using dental enamel for *in-vivo* radiation dosimetry depends upon resolving the above discrepancies between the doses calculated by treatment planning and the doses determined by ESR in dental enamel.

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## Mohl'isms

"Clinical research, which involves human subjects, is essential for translating basic knowledge into usable modalities for health care."

Norman Mohl.

"....clinical success, however noteworthy, are not scientific proof of cause and effect."

Norman Mohl

"...., it is unreasonable to expect full-time clinical dental faculty, most of whom have large teaching loads, to engage in basic science research in "wet" laboratories where the research issues may be far removed from their everyday activities and interests. It is not unreasonable, however, to expect clinical faculty to collaborate in clinical research projects, since such activities are closely linked to their primary interests and skills."

Norman Mohl.

"....clinical research, because it encounters many confounding variables, must often pay more attention to the proper use of the scientific method and research principles than some basic research."

Norman Mohl.

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See page 3 for news of  
Clinical Research Day.  
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## Comprehending

"Science seen as a communal activity is, in the end, an interplay between the discovery itself and those to whom it also becomes property- those who elaborate it, work it out, take the next step, lead on to other things. And this interplay can be exciting even to those who have nothing to do with the discovery except the actual pleasure of comprehending it."

Jacob Bronowski.

## CLINICAL RESEARCH DAY

Although our laboratory research in the Faculty of Dentistry at Dalhousie University has been well established for many years, our faculty does not have the tradition of strongly participating in clinical research. The Research Development Committee have arranged a Clinical Research Day for Wednesday, 12th April 1995. The programme will commence at 12.30 pm with a presentation by one of our clinical colleagues in Medicine Dr. Richard Goldbloom who will make a presentation entitled "Why clinicians need to do research." This will be followed by a short session in which four 15 minute (IADR type) papers are presented on aspects of clinical research conducted by our faculty members. Dr. Norman D. Mohl, of the School of Dental Medicine, SUNY Buffalo, will then make a presentation and conduct a workshop dealing with clinical research. It is planned that the programme will have a break for a light meal and continue the workshop until conclusion at 7.00 pm. Make a note of the date and plan to be present at what will be a very valuable and interesting session.

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### Scientific Progress

"Remember, then, that scientific thought is the guide of action; that the truth at which it arrives is not that which we can ideally contemplate without error, but that which we may act upon without fear; and you cannot fail to see that scientific thought is not an accompaniment or condition of human progress, but human progress itself."

*William Clifford*

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The second paper being presented by Barry Pass is as follows.

### COMPARISON OF DOSIMETRY BY BIOLOGIC TECHNIQUES AND BY ELECTRON SPIN RESONANCE IN DENTAL ENAMEL AND CLOTHING FOR ACUTE EXPOSURES FROM THREE RADIATION ACCIDENTS

B.Pass, A.E. Barnaov, J.E. Aldrich, P. Scallion, and R.P. Gale.

Radiation dose and distribution for acute exposures is estimated by physical measurements using Electron Spin Resonance (ESR), biologic dosimetry and computer simulation. ESR is used to detect free radicals produced by radiation in aberrations in blood lymphocytes and the kinetics of granulocyte production following the exposure.

In the present study one victim of the Chernobyl nuclear accident, one victim of an unspecified accident involving gamma and neutron radiation, and one victim of an accidental exposure to a radiation sterilization source, were studied for radiation dose determination.

The Canadian laboratory, using the Electron Spin Resonance (ESR) calibration curve technique, determined that the victim of the Chernobyl nuclear accident was exposed to  $8.0 \pm 1.0$  Gy. This result agrees well with dose estimates by the Russian laboratory using the ESR additive dose technique and cyto genetics. This individual, a fireman who fought the fire in the Chernobyl reactor from the roof of the building, died of acute radiation sickness.

The second victim sustained an accumulated absorbed dose to dental enamel of  $7.2 \pm 1.0$  Gy, as determined by ESR in the Canadian laboratory. This result

is in good agreement with Russian ESR measurements, computer simulation and personal dosimetry. Neutron radiation was estimated to account for 25% of the total dose. This individual lived for 17 years following the accident.

The third victim reported on here entered a gamma-radiation chamber used for sterilizing medical supplies. The  $^{60}\text{Co}$  source (specific activity,  $8 \times 10^5$  Ci) had not retracted properly. The total exposure time was estimated at 1 to 2 minutes. Dose estimates by Russian researchers, using computer modeling, cytogenetic techniques assessing chromosome aberrations in cultured blood lymphocytes, blood granulocyte kinetics, pooled biologic dose estimates, and ESR in dental enamel and clothing material, indicated an exposure range of 9 to 16 Gy. ESR studies of dental enamel in the Canadian laboratory determined the exposure to be  $13.7 \pm 1.4$  Gy, in good agreement with the Russian estimates.

The 50% lethal dose to bone marrow in humans is 3 to 4 Gy. Hematopoietic suppression is considered irreversible with doses exceeding 8 Gy. Partial hematopoietic recovery was achieved with the third subject, however, in a Russian hematology ward, using supportive measures, transfusions, and hematopoietic growth factor but no transplants. The patient died 113 days following the accident from radiation pneumonitis infection instigated by diffuse and focal fibrosis of the lungs.

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### Act of Discovery

"What is important in science is not the initial act of discovery, but the continuing search for truth."

*Jacob Bronowski.*