

Dental

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Research News

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YET ANOTHER RECORD

This year we see yet another record number of abstracts being submitted to the IADR from the Faculty of Dentistry at Dalhousie University. The total of 34 abstracts is quite remarkable for the size of our faculty. Clearly we have an established environment which is conducive to research and academic pursuits. Some have been saying how long can we keep increasing the level of research activity within the faculty. We should of course not equate the numbers of research abstracts each year with the level of research activity. Often such research will only represent preliminary data and as such requires consolidation and further work, as a prelude to a full publication in a refereed journal. On the other hand it may also be the prelude to submission of a research grant application. It is almost certain that the number of Abstracts for the IADR will not be as high

for the next two years due to the high cost since the IADR/AADR meetings will be held in Acapulco, Mexico in 1991 and the IADR in Glasgow Scotland in 1992. However, the separate AADR meeting will be very close to us in 1992 when it will be held in Boston. Perhaps 1992 could be yet another record year?. In addition the meeting in 1993 will also be closer to home when the joint IADR/AADR meetings will be in Chicago.

This Month's Special Edition of the Research News features coverage of some of our ongoing research in the Faculty based upon the submission of thirty-four IADR abstracts.

Research and Teaching

"Research and teaching are inseparable. If research were to end today, you would know what you know and you would know no further....."

Robert Fournier

Welcome to New Research Staff

The Department of Applied Oral Sciences is pleased to welcome four new research staff members who have joined the Division of Dental Biomaterials Science team working on the MRC Programme Grant. The new members are Barbara Ruszel Research Assistant who has an MSc in Chemistry from the Technical University of Gdansk in Poland. Barbara worked at the Institute of Inorganic Chemistry at the Technical University of Gdansk for 14 years and was a Senior Research Assistant for the past nine years. Other new members are John Dwyer and Darren Hilchey Technicians who are both graduates of the Cooperative Education Programme in Chemical Engineering Technology at the University of Cape Breton. The fourth new member of the team is Pirooska Hidi who will be working mainly on experiments involving biocompatibility of our biomaterials. The four new members of our team will be joining Chief Technologist Gordon Hall, Senior Technician Maxine Langman and Research Assistant Kathy Robertson in the busy biomaterials research laboratory.

34 Abstracts Submitted to IADR

The following thirty-four abstracts have been submitted to the IADR from our faculty.

- 1) Retrospective Evaluation of Long Term Temporary Cementation in Fixed Prosthodontics. C.A. BAIN* (Oral).
- 2) The Effect of CO₂ Laser Radiation on Enamel Crown Margins *In Vitro*. T.L. BORAN*, K.L. ZAKARIASEN and J. PETERS (Poster).
- 3) Influence of Processing Techniques on Maintenance of Centric Occlusion Contacts. O. SYKORA, E.J. SUTOW and A.M. BROWN* (Poster).
- 4) The Effect of Two Surface Coating Formulations on *In Vitro* Dynamic Flow of a Resilient Denture Liner. R.M. BRYGIDER*, B. GRAHAM, and G. CREIGHTON (Oral).
- 5) The Effect of Two Surface Coating Formulations on *In Vitro* Leaching of Plasticizer from a Resilient Denture Liner. R.M. BRYGIDER, B. GRAHAM, and G. CREIGHTON* (Oral).

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(Abstracts Submitted cont.)

- 6) Effect of Margin Design and Location on Dicor Crown Strength. G. DOYLE*, K. MOORE, C. GOODACRE and C. MUNOZ (Oral).
- 7) Influence of Cell Density on Agar Overlay Cytotoxicity Testing. W.C. FOONG*, R.E. HOWELL, S. PYKE, D.W. JONES (Oral).
- 8) Antifungal Drug Delivery Using Commercially Prepared Soft Polymer-Gel Systems. K.A. GATES*, W.C. FOONG, D.W. JONES, M. MEZEI (Oral).
- 9) The Analysis of 11 Commercial Soft Polymer Powders. D.W. JONES, G.C. HALL*, E.J. SUTOW, M.F. LANGMAN & K.N. ROBERTSON (Poster).
- 10) Effect of Topical Liposomal and Nonliposomal Steroids on Experimental Ulcers. B.B. HARSANYI*, P. HIDI, M. MEZEI (Oral).
- 11) Prevalence of Dental Caries and Fluorosis in F and non-F Cities in Quebec. A. ISMAIL*, J-M BRODEUR, M. KAVANAGH (Oral).
- 12) Elastic Moduli and Poisson's Ratio of Dimethacrylate Polymers. D.W. JONES, G.C. HALL, C. JOHNSON*, A.S. RIZKALLA & E.J. SUTOW (Poster).
- 13) Comparison of Static and Dynamic Elastic Moduli for Methacrylate Polymers. J.A. JOHNSON*, D.W. JONES, A.S. RIZKALLA & H.W. KING (Oral).
- 14) Effect of Silane Treatment on Elastic Moduli & Poisson's Ratio of Experimental Composites. D.W. JONES*, A.S. RIZKALLA, E.J. SUTOW, & G.C. HALL (Oral).
- 15) *In Vitro* Cytotoxicity of Methacrylate Monomers. W.C. FOONG, R.E. HOWELL, C. KARST*, E.J. SUTOW, D.W. JONES, M. MEZEI (Poster).
- 16) Natural History of Tooth Mobility. A. ISMAIL, M. KAVANAGH* (Poster).
- 17) Thermal Expansion and Strain Point of Dental Porcelains. D.W. JONES, A.S. RIZKALLA, E.J. SUTOW & E. LENARCZYK* (Poster).
- 18) Comparison of Lased and Acid Etched Enamel Using Scanning Electron Microscopy. R.M. MacDONALD*, K.L. ZAKARIASEN, J.F.M. PETERS, S. BEST (Poster).

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- (Abstracts Submitted cont.)
- 19) Placement and Replacement of Restorations in a Military Population. W.A. MacINNIS*, A. ISMAIL, H. BROGAN, M. KAVANAGH (Poster).
- 20) Effects of Air Polishing on Various Composite Resins. C.A. BAIN and M.E. MADER* (Oral).
- 21) Comparison Temperature Changes in CO₂ Lased Dentin. K. ZAKARIASEN, J. BARRON, D. MILLER*, J. PETERS, T. BORAN. (Poster).
- 22) Gel Strength and Gelation of Drug Containing Prosthodontic Soft Polymers. K.M. OZCAN*, D.W. JONES, W.C. FOONG, M. MEZIE & E.J. SUTOW (Oral).
- 23) Enamel Biopsy and Tooth Restoration for Measurements of Radiation Exposure from Nuclear Accidents using ESR. B.PASS* and J.E. ALDRICH (Oral).
- 24) Types of Root Caries Lesions In An Elderly Institutionalized Population. A. ISMAIL, C. PERRIN*, R. MacDONALD, W. MacINNIS, M. KAVANAGH (Poster).
- 25) Effects of Pulsed/Nonplused CO₂ Laser Energy on Enamel Demineralization. J.F.M. PETERS*, K.L. ZAKARIASEN, T.L. BORAN, J.R. BARRON (Poster).
- 26) Accuracy of Different Die Stone and Impression Material Combinations. R.B. PRICE*, J.D. GERROW, E.J. SUTOW & R. MacSWEEN (Oral).
- 27) Structural Incompatibilities Limiting Incorporation of K₂O in Feldspathic Porcelains. A.S. RIZKALLA*, D.W. JONES, G.C. HALL & E.J. SUTOW (Oral).
- 28) Influence of Surface Finish on the Cytotoxicity of Dental Amalgam. E.J. SUTOW, W.C. FOONG, A.S. RIZKALLA, D.W. JONES, K.A. RUSSELL* and R.E. HOWELL (Oral).
- 29) Citric Acid Concentration Range for Dentin Demineralization. J. STERRETT*, B. DELANEY, A. RIZKALLA and C. HAWKINS (Oral or Poster).
- 30) Simplified Surface Treatment for Porcelain Bonding to Base Metal Alloys. E.J. SUTOW*, D.W. JONES, A.S. RIZKALLA and R.A. RAFTUS (Oral).

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(Abstracts Submitted cont.)

31) Influence of Different Waxes on the Occlusion of Complete Dentures. O. SYKORA* and E.J. SUTOW (Poster).

32) Utilization of Dental Services by a Community of Retired Religious. J.CLOVIS*, M.FORGAY, A.ISMAIL, C.PERRI N, R.MACDONALD and W.MACINNIS

33) Changes in Pediatric Dentistry Patient Needs in Two Clinic Locations. I.C. BENNETT*

34) Validity of a Structured Admissions Interview. M.BOYD* and I. C. BENNETT.

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The Range of our Dental Research

Many of our colleagues across the Dalhousie campus would be very surprised to learn of the very wide range and breadth of our research activity in the Dental Faculty. As judged by our recent submissions to the IADR meeting next March we have research involving the following areas:-

CERAMIC MATERIALS

Crowns made from a Tetrasilicic-Micaglass-ceramic (K₂O-MgF₂-MgO-SiO₂) produced by a casting process are commonly used in fixed prosthodontics. A study has been made by

Gorman Doyle and colleagues of the effect of the design of the margin of the crown on strength. Three different designs were evaluated. It was found that a shoulder finish line with a sharp axio-gingival line angle produced the greatest strength for the crown restoration.

A further study has involved the surface treatment for porcelain bonding to base metal alloys. The purpose of this study was to determine whether the manufacturers' complex multiple step surface preparation procedures for cast porcelain fused to metal base metal alloys could be replaced by a simplified, experimental technique, without a subsequent reduction in porcelain bond strength. A total of eleven alloys were investigated. The control group was surface prepared for porcelain application, as per manufacturers' directions. The experimental group was surface prepared by only grinding the cast surface with wetted 320 grit SiC paper, followed by high pressure blasting with 50 μm particles, prior to porcelain application. Opaque porcelain was applied and fired to the control and experimental group, in the same manner. Ten specimens were tested for each alloy, in each group, for a total of 220 specimens. Bond strength was

evaluated using a shear test. Results showed that in comparison with the manufacturers' directions, the experimental surface treatment lowered the bond strength of 3 alloys, raised the bond strength of 1 alloy, and showed no statistical differences for the remaining 7 alloys. Dr. Elliot Sutow who directed this project was able to conclude that some manufacturers' directions should be examined for possible simplification of the surface preparation procedure.

A further project involving porcelain is also being conducted in the Biomaterials laboratory as part of the MRC Programme Grant. This project involves a study of the thermal expansion and strain point of dental porcelains. Residual stresses are known to effect the service life of porcelain-fused-to-metal restorations. Metal-porcelain contraction, mismatch of thermal expansion of alloy and porcelain as well as the thermal history of porcelain and metal significantly contribute to residual stresses. The objective of this study was to compare thermal expansion and strain point of commercial porcelains. A study was made of the influence of firing temperature and holding time at specific temperatures on the above properties. Linear thermal exp-

ansion values were determined for a range of commercial dental porcelain materials. Firing time and holding time were both found to influence the strain point. One material was found to produce transition points both above and below the strain point which may lead to some problems with this type of material. This study of thermal expansion coefficients at different temperatures will be of considerable help in the goal of developing new types of porcelain/glass systems for fusing to metal which hopefully may have improved properties.

A further project from the MRC Programme Grant involves a basic fundamental study of structural incompatibilities limiting the incorporation of K_2O into feldspathic porcelains. The objective was to determine the limitation of K_2O which can be incorporated into a feldspathic glass as a result of variations in the ratio of Na_2O to silica network formers. A total of 14 different 8 component glasses were produced using wet chemistry. Three samples of each 8 component glass were dissolved and analysed for each element using Atomic Absorption Spectrophotometry in order to obtain the bulk chemical compositions. This procedure involved a total of 336 analyses. This study has

been able to clearly show the point at which the % of Na₂O began to have a limitation on the K₂O content. The K₂O level began to decrease at approximately 5% Na₂O and was significantly decreased at 15% Na₂O. The data provide for the first time clear indications for the limitations in the formation of feldspathic glass compositions capable of producing leucite crystallization.

POLYMER RESEARCH

A further project being conducted in the biomaterials research laboratory involves evaluation of the elastic moduli and Poisson's ratio of dimethacrylate polymers. Various dimethacrylates are used as matrix resins in dental restorative composite systems, as resin cements or as pit and fissure sealants. The objective of this study was to compare the elastic moduli for a range of different polymer blends. Polymers evaluated were Ethoxylated Bisphenol A Dimethacrylate (EBAD) and Bisphenol-A Glycidylmethacrylate (BIS-GMA). These materials were diluted with 1-55% Triethylene Glycol Dimethacrylate (TGD). The materials were evaluated using an ultrasonic wave technique. Sound velocity and density measurements were made on each specimen, allowing values of Young's, shear, and bulk

moduli to be calculated. Poisson's ratio ranged from 0.342 to 0.356. The EBAD polymer was found to have the lowest Young's modulus (4.28 GPa). Incremental additions of TGD to this polymer progressively increased the Young's modulus of the mixture and at 26% TGD the Young's modulus value was 4.42 GPa. BISGMA polymers diluted with the TGD had a significantly higher Young's modulus than the EBAD polymers ranging from 5.39 GPa for the 55% TGD to 5.78 GPa for the 15% TGD. A significant difference was found between the modulus values for BISGMA polymers containing 15% TGD and those containing 50% TGD. These results will aid in the development of improved composite systems.

A further study of some fundamental properties of polymers involves a comparison of static and dynamic elastic moduli of methacrylate polymers. Such polymers may be used in prosthodontics polymers or in orthopedic cement systems. The objective of this project was to compare static and dynamic (sonic) moduli of polyethyl-methacrylate (PEMA), poly-methyl-methacrylate (PMMA) and poly-butyl-methacrylate (PBMA). These three polymers were produced in our biomaterials research

laboratory by bulk polymerization from pure monomers using benzoyl peroxide initiation. Dynamic modulus of elasticity (shear, longitudinal and bulk) and Poisson's ratio were determined using lithium niobate crystals and an ultrasonic wave technique at 10 MHz resonant frequency. Velocity and density measurements were made on cylindrical specimens of each polymer. The moduli and Poisson's ratio could then be calculated from velocity and density measurements. In addition static moduli were determined using a conventional mechanical testing machine. The static Young's moduli values for the three polymers were PMMA 3.20 GPa; PEMA 2.02 GPa and PBMA 0.57 GPa. The dynamic values were PMMA 6.29 GPa; PEMA 3.96 GPa and PBMA 2.13 GPa. A significant difference was found between the three polymers for both static and dynamic tests and between static and dynamic moduli for each polymer. The % difference in static vs. dynamic Young's moduli were PMMA 97%, PEMA 96% and PBMA 274%. The dynamic Poisson's ratios were PMMA 0.306; PEMA 0.343 and PBMA 0.386. This data will be an aid in the development of co-polymers having specific mechanical properties.

One of the active areas of research activity in the Biomaterials Programme is the chemical analysis of polymer systems. A recent study involved analysis of commercial soft polymer materials. The objective of this project was to determine the composition and molecular weights of a range of commercial dental soft polymers. The products from thermally decomposed polymers were collected at 0.0°C in ether traps. The monomers were then analyzed by a G.C. programmed run from 35°C to 200°C. The majority of the materials were found to be methyl methacrylate copolymers with a smaller amount of ethyl methacrylate. A study of the molecular weights indicated that the peak molecular weights of the 11 polymers were between 1.7×10^5 and 3.5×10^5 . This basic information will provide a guide in the refinement and development of new polymer systems.

PHARMACEUTICAL RESEARCH

An additional area of our biomaterials research involves the incorporation of drugs into polymer materials as slow release systems. A significant number of edentulous patients are unable to wear their dentures regularly

due to discomfort and oral fungal infections. Part of the problem using conventional drug therapy is due to the low intra-oral drug residence time combined with poor patient compliance. A study has been made of the *in vitro* efficacy of three commercial denture soft lining materials in which concentrations of antifungal agents nystatin and ketoconazole were incorporated. The polymer discs containing drugs were placed on Sabouraud dextrose agar plates inoculated with *Candida albicans*. The area of inhibition around the discs at 3 and 7 days gave a measure of the antifungal activity. The study was able to show that it may be possible to customize a drug release profile using different types of polymer gel systems.

It is important to determine the influence of drug incorporation on the physical properties of the polymer systems. One such study involves an evaluation of gel strength and gelation of drug containing prosthodontic soft polymers. The objective of our recent study was to compare the influence on gel strength and gelation time of combinations of the two drugs together Econazole and Nystatin. Further variables which we have evaluated were the dispersion of the Econazole in ethyl alcohol rather than as a

powder in the polymer. An additional variable studied was the effect of powder liquid ratio. The gelation times were evaluated at body temperature using a reciprocating rheometer. A puncture test method developed in the biomaterials laboratory was used to evaluate gel strength. Incorporation of Nystatin on its own or Nystatin together with Econazole in ethyl alcohol did not significantly reduce gel strength. Econazole alone and Econazole (powder) with Nystatin was found to significantly reduce the gel strength. Gelation time was also significantly effected by the Econazole. In all cases the gel strength was found to increase with powder liquid ratio.

A further project which involves the use of drugs is a study made of the effect of applying topical liposomal steroids as a means of treating oral and cutaneous ulcers. Liposomal encapsulation has been shown to increase local and decrease systemic concentrations of triamcinolone acetonide when applied to both the skin and to oral ulcers. The study has been conducted on a hamster model for ulcers. The findings of this study by Barbara Harsanyi and Mike Mezei were that both liposomal and non-liposomal

steroid treatment decreased inflammation and retarded wound healing. It was found that liposomal encapsulation did not suppress the drug action.

CYTOTOXICITY OF METALLIC BIOMATERIALS

One of the most commonly used dental biomaterials is silver amalgam, much controversy exists about its potential toxicity. One of the projects being submitted for presentation at the IADR meeting next March involves the influence of surface finish on the cytotoxicity of dental amalgam. Finishing dental amalgam after carving has been shown to increase corrosion resistance. However, it is not known whether the finishing procedure affects biocompatibility. It was the objective of this study to determine if varying the degree of finishing of amalgam would influence its *in vitro* cytotoxicity. Two alloys, Dispersalloy and Tytin, were used to determine the effect of three different finishing techniques: 1. carved and burnished, 2. carved, burnished and polished and 3. carved and polished. The carved-only specimens served as controls. Specimens were condensed and finished using controlled methods. Before testing the specimens were aged in air at 37°C for the following times: 20

minutes, 1 hour, 1 day, 1 week or 4 weeks. Cytotoxicity was assessed using an internationally recommended agar overlay test. The evaluation of the plates were conducted blind. Five specimens were tested for the controls and for each surface finish and time period, for a total of 200 specimens. Results showed that throughout the four week period no one finishing technique was consistently superior. However, for periods greater than 20 minutes and 1 hour for Dispersalloy and Tytin alloys respectively, all 3 finishing techniques, compared with controls, significantly decreased cytotoxicity. Elliott Sutow who supervised this project was able to conclude that surface finishing amalgam after carving increases biocompatibility.

CYTOTOXICITY OF ORGANIC BIOMATERIALS

A further study being undertaken as part of our MRC Programme Grant which involves an evaluation of the biocompatibility of monomers used in producing dental polymers. Results submitted to the IADR meeting for 1990, involve an *In vitro* Cytotoxicity study of Methacrylate Monomers. The biocompatibility of methyl methacrylate polymer has been extensively investigated.

However, there are few studies on the biocompatibility of the higher methacrylate (MA) monomers and polymers. The purpose of this study was to determine and compare the cytotoxicity of the following methacrylate monomers: mono-methyl methacrylate (MMMA), mono-ethyl methacrylate (MEMA), mono-butyl methacrylate (MBMA) and mono-lauryl methacrylate (MLMA), using our newly described liposome-neutral red cytotoxicity test (Howell *et al.*, 1989, IADR). The concentration effect of liposome entrapped compounds on the neutral red content of NIH 3T3 cells has been measured spectrophotometrically. Ten-fold dilutions of liposome entrapped MMMA, MEMA, MBMA and MLMA incorporated in culture media gave 5 concentrations (n=6) of 10 mM to 1 μ M for each compound. Liposome entrapped dibutyl tin diacetate (DBTD) was the positive control. No difference was seen between negative controls and "empty" liposomes. Neutral red absorbance at all test sample concentrations was less toxic than the positive control. A dose dependant concentration effect for each compound was observed. A significant difference was found at at 1×10^{-2} M (control <BMA=EMA< MTA<LMA<DBTD). From this study it was possible to

conclude that the toxicity of methacrylate monomers were dose dependent. Lauryl methacrylate was found to be the most toxic monomer studied, which may be related to its high molecular weight.

As part of our on-going research programme in biomaterials we are aiming to produce improved biocompatibility tests. The agar overlay cytotoxicity test (AOCT) is a recommended international standard method. However, variable results are obtained using this method. Furthermore, using this test, known toxic phthalate esters, diethyl hexyl phthalate (DEHP) and dibutyl phthalate (DBP) have been shown to be non-toxic (Lovas *et al.*, 1988 IADR). A further study has evaluate the influence of cell density on AOCT. Cells were plated to give 50 or 100% cell density in six well plates. Phthalate esters; butylphthalyl butyl glycolate (BPG), DEHP, DBP and the positive control, dibutyl tin diacetate (DBTD) were tested by

(a) using impregnated filter discs (1 cm diam.), the negative control used was the culture medium (DMEM) and

(b) the test compound or positive control in ethyl alcohol were incorporated into soft polymer discs.

The test specimens contained approximately 37% ester. Negative control polymer discs contained only ethyl alcohol. All ethyl alcohol in the polymer discs were driven off after 24 hours incubation at 37°C. ACOT was evaluated in accordance with the international standard procedure. DBTD (positive control) was consistently the most toxic compound. At 50% cell density, filter paper impregnated with DEHP was more toxic than DMEM but was less toxic than BPBG or DBP. However, at 100% cell density, DEHP was more toxic than BPBG or DBP. At 50% cell density, polymer discs containing DBP and DEHP were more toxic than BPBG and at 100% cell density, DBP was less toxic than DEHP. It was concluded from this study that the percentage cell density used in the agar overlay cytotoxicity tests may influence the toxicity data obtained.

COMPOSITE MATERIALS

A further study being conducted in the Biomaterials research laboratory involves development of composite restorative materials. Evaluation of the effect of silane surface treatment of ceramic filler on the elastic moduli and Poisson's ratio of experimental composites materials has been undertaken. The aim was to determine the

influence of silane treatment on the dynamic modulus of elasticity (shear, longitudinal and bulk) and Poisson's ratio for two experimental composite systems containing various volume fractions of filler. Two ceramic filler systems which had been synthesized by wet chemistry in our biomaterials research laboratory were evaluated. The filler was varied from 0-59% by volume for filler 'A' and from 0-48% volume for filler 'B'. Moduli and Poisson's ratio were calculated from sound velocity and density measurements. A significant difference was found between the materials containing the silane treated filler and the non-silane treated materials. Bulk moduli for silane treated samples were between 2% and 21% higher than the non treated filler samples depending upon type and filler volume. An interesting finding was that values of elastic moduli for one filler at 20% volume loading which was not silane treated had a similar modulus value to a silane treated filler composite material containing only 6% of filler. This interesting data may one day enable development of improved dental restorative filling materials.

The polishing and cleaning of tooth surfaces with an air jet

propelled slurry of bicarbonate of soda has been used in dentistry for some time. Effects on tooth enamel have been well documented. However, little information has been produced to date for the effect of this technique on restorative materials. A study of the effect of a jet polishing system on the surface of four composite restorative materials has been undertaken. The surface roughness was determined by means of a profilometer. The study shows that the jet polishing method produces greater surface roughness on composite resin materials than conventional prophylaxis. Dr's Bain and Mader warn that jet polishing should be used with care on those teeth which have been restored with composite restorations.

DENTAL STUDENT SELECTION

A study has been made in an attempt to validate the Canadian Dental Association (CDA) structured dental admissions interview. The desirable characteristics had been identified then prioritized by faculty "experts". Initial ranking of the eight criteria identified responsibility as the most important, then motivation, ability to relate, maturity, ethics, self-appraisal, adaptability and last, an

overall assessment. Training workshops for faculty, student and practitioner interviewers were conducted to establish and maintain inter-rater reliability in the range of .68 - .87. Attempts to assess predictive validity following selection proved unsuccessful as an appropriate and uncontaminated criterion and could not be identified. To test content and construct validity after six years of use, the "experts" (n=102) were asked to assess again the importance of the eight characteristics and their ability to evaluate them. Their new ranking lowered responsibility to 3rd rank and raised overall assessment to 5th rank. The "experts" ability to collect information ranged from 89% for motivation to 63% for adaptability and the ability to assess information collected ranged from 85% for maturity to 57% for self-appraisal and adaptability. Following this study Marcia Boyd and Ian Bennett were able to conclude that None of the "experts" raised any reasons to discourage the use of the CDA interview in the dental admissions process.

CLINICAL RESEARCH

A retrospective eight year study of the use of long term temporary cements for crown and bridgework has been undertaken. 760 units

have been evaluated 53 single crowns and 143 bridges were cemented with the temporary cement. Only 8.4% of maintenance problems could be attributed to temporary cementation. Cost analysis of this against the cost benefit in other problems where the temporary cement in fact facilitated maintenance gave a benefit to cost ratio of 7.85:1. 82% of all problems were found to occur in the first year. This study conducted by Dr. Crawford Bain concluded that use of temporary cements in fixed prosthodontics facilitates the correction of maintenance problems and the use of such cements should be given very serious consideration.

A study has been conducted of the risk factors associated with development of tooth mobility. If we are truthful we all have fears of tooth mobility. A sample of 165 dentate individuals were examined 29 years ago in 1960 and again in 1978. Tooth mobility was measured using a standard method. The results showed that 21 adults had at least one tooth which was mobile in 1960. Out of 100 mobile teeth in 1960 55 remained mobile by 1987 and 45 were lost. This study by Amid Ismail and his colleague shows that individuals with mobile teeth at base-

line in 1960 had a higher incidence of tooth loss and tooth mobility in 1987 than those individuals who were free of mobile teeth in 1960.

A clinical study has been conducted to investigate the reasons for placement and replacement of dental restorations. The study was based on military personnel for treatment undertaken by the 34 military dentists in the four Atlantic provinces. The data was collected over a period of 30 working days. All dentists used the same pilot tested data collection form. A total of 2,280 restorations from 643 adults, 18 to 57 years were documented. A total of 54% of the restorations were first placements and 46% were replacement of existing restorations. Surprisingly no difference in replacement rates was reported between amalgam and composite restorations. The major reason (90%) for placement was primary caries and the major reason (40%) for replacement was recurrent caries. A total of 12% of replacements were found to be due to fractured restorations. Bill MacInnis and colleagues were able to conclude that about half of the restorative work carried out in the study were replacements of existing restoration. Caries was found to be the primary reason

for placement and for replacement of the restorations.

Some very interesting work is also being conducted by Dr. Amid Ismail and his group who have been studying the prevalence of dental caries and fluorosis in fluoridated and non-fluoridated cities in Quebec. The purpose of their study was to evaluate the difference in dental caries and fluorosis prevalence in 936 randomly selected life-long residents from public and private schools, in Trois-Rivières (1.0 ppm F in 1987), and Sherbrooke (< 0.1 ppm F). Students were examined using established criteria. Because of inconsistent fluoridation levels in Trois-Rivières, comparisons were carried out between two age strata: students 11-14 years of age, who consumed for a longer duration suboptimally fluoridated water than those in the 2nd stratum: students 15-18 yrs of age. Only public school students, 15-18 years of age, from Trois-Rivières, had significantly lower mean fluorosis and DMFS scores (29% and 24% respectively) than similar students in Sherbrooke. Among private school students, no similar differences were found, except in the youngest age group in Sherbrooke who had significantly lower mean DMFS than similar students

from Trois-Rivières. The prevalence of fluorosis was about 30% in Sherbrooke students, and 55% in Trois-Rivières students. The use of fluoride tablets was significantly associated with fluorosis. This study showed that water fluoridation benefitted students from public schools and that the risk factors of dental fluorosis were the use of fluoridated water combined with the use of fluoride tablets.

The determination of exposure to Nuclear Accidents presents a dilemma for the public the politicians and the medical profession. However, one method which is the subject of research by Barry Pass makes use of the fact that dental tooth enamel maintains a record of a tooth's exposure to X- and γ - radiation. The absorbed dose is stored in the form of long-lived free radicals that can be detected using Electron Spin Resonance (ESR). In a recent study it was found that exposures to diagnostic radiation were significantly higher for nuclear Veterans. A simple biopsy method has been developed in which a restoration can be completed very quickly using light cured composite materials.

The declining numbers of young patients who have dental treatment requirements

presents a problem for many dental educational establishments. The hypothesis tested was that the changing demand for patient care created a situation where student experiences at an extra-mural clinic offered a better location for the development of clinical skills than the dental school. The clinic computer system provided figures for the numbers of patients seen, the number of patient visits, the fees collected and the Relative Value Units (RVU's) of treatment completed at each location from 1984-5 to 1987-8. Results showed that, on a per student basis, patients seen had fallen from 15 in 1984-5 to 12 in 1987-8 (down 20%), patient visits from 80 to 44 (down 45%), fees generated from \$1495 to \$1142 (down 24%) and RVU's from 270 to 145 (down 46%). However the average productivity per student had only changed from 62 RVU's to 60 RVU's (down 3%) at the extra-mural facility but fallen from 208 to 85 (down 59%) in the dental school clinic. RVU's per patient visit had increased in the satellite location from 2.8 to 3.0 (up 7.4%) but had fallen from 3.6 to 2.6 (down 28%) at the dental school. Since it was assumed that the amount of treatment needed was the principal influence on the amount of

experience the students gained, it was concluded by Ian Bennett in this study that maximum use of the satellite clinic was the most productive use of the students time.

Information about the utilization of dental services by older adults is also critical in order to formulate predictions about future requirements for care. A study has been conducted to determine oral health needs of an institutionalized population of older adults. Information on utilization of dental services was obtained from interviews conducted by a single interviewer for those who were ambulatory and living in a residence. The interview focused on four areas: self-perception of general health and dental health, preventive health behaviours, and utilization of dental services. Data collected included: choice of provider (dentist or denturist), time since last visit, immediacy of treatment after making contact, reason for the visit, levels of satisfaction with the visit, and the reasons for not visiting a dentist within the past year. Relative to the general population of older adults, the subjects more frequently reported regular maintenance by private dental practitioners. The reported high level of contact with a

private dentists was most likely influenced by payment for the services by the institution. The main reasons for not visiting a dentist in the last year included fear and dislike, distance from dental office, and medical problems. Jo-Anne Clovis and colleagues were able to conclude from this study, that differences between these subjects and the general population of older adults in utilization of dental services, illustrate the need to look at sub-group characteristics when planning dental health care for the elderly.

Getting older most often also goes together with getting long in the tooth. The incidence of root caries is becoming the subject of interest for researchers with the increasing numbers in our aging population. A study of root caries lesions has been conducted for an elderly institutionalized population. A total of 60 elderly dentate females participated. Root caries was diagnosed in 93%. Dr. Ismail and colleagues were pleased to report that in the well-maintained elderly, despite the high prevalence of root caries, the need for treatment is low and preventive maintenance can play a significant role.

A study of demineralization using

various citric acid concentrations has produced results which John Sterrett and colleagues believe may be of significance in regenerative procedures which use calcium root demineralization. The purpose of the study was to delineate the optimal concentration of calcium for dentine demineralization. The *in vitro* tests were conducted on bovine molar teeth. Tape with 2mm diameter holes was placed on the teeth to provide a known area exposed to the acid. The calcium removed from the dentine surface was evaluated by atomic absorption spectrophotometry. The results indicated that there is an optimal calcium (buffering) concentration beyond which demineralization decreases.

LASER RESEARCH

A number of studies are under way in the faculty under the direction of Ken Zakariassen involving the application of lasers in clinical dentistry. One such *in vitro* study involves the effect of CO₂ laser radiation on tooth enamel as a means of inhibiting progression of carious lesions. The study has examined the anticarious effect of low-level radiation on the enamel crown margins of fifty extracted third molars. The teeth were covered with acid resistant varnish with two

small windows left uncovered and free of varnish. The one uncovered area being the test site the other acting as a control. The experimental window was lased with 2.5 or 1.5 watts for 0.15 seconds. The teeth were then placed in an artificial caries solution for 12 days and the resulting carious lesions examined by polarized light photomicrographs. The results of this study indicated that the low level laser radiation significantly reduced the area of the carious lesions. A further aspect investigated involved a comparison of pulsed and non-pulsed laser energy as a means of reducing demineralization of enamel in artificially produced incipient caries lesions. These results further indicated that both pulsed and non-pulsed laser energy reduced demineralization.

An additional study using lasers compared the roughness of tooth enamel produced by laser and by acid etching. An *in vitro* study was conducted using extracted molar teeth. Four zones of the teeth were treated differently, two areas served as controls whilst the other two areas were either acid etched or lased. The treated sections were then examined by SEM. Under the conditions of this study, laser energy appeared to have the potential to produce a rougher

surface than standard acid etching. However, if laser roughening is to replace conventional acid etching technique further studies on both exposure parameters and resin bond strength to lased enamel will be required.

A further aspect of using lasers *in vivo* is the potential damage to the living cells. An intensive study is progressing in order to determine the temperature changes in lased dentine. A recent study has evaluated both the peak temperatures as well as the time for temperatures to regress from peaks towards ambient levels. It was found that temperature elevations and time intervals for regression toward ambient levels following lasing of dentine were relatively modest. In order to provide a good safety margin the study used lasing parameters which were far in excess of those which would be necessary for preventive clinical applications.

PROSTHODONTIC RESEARCH

The occlusal harmony of complete denture prostheses is extremely important to their functional effectiveness. A study has been made comparing dentures made from a continuous injection moulding technique and by the conventional trial pack technique. A comparison was

made of occlusal contact points on the dentures before and after processing using the two methods of fabrication. The loss of occlusion contacts was 26% smaller for the continuous injection technique. Oskar Sykora who has directed this study concluded that the injection technique resulted in less errors in the occlusal contacts of full dentures.

A further study has also been made of the possible effect on occlusion of full dentures of using base plate waxes which have different coefficients of thermal expansion. The conclusion to this study was that external factors, such as the care in manipulation of the wax and the storage conditions of the trial dentures, probably masked out any intrinsic differences between the two waxes tested which would have been related to their material properties.

A motor-driven beam apparatus designed in the biomaterials laboratory to simulate mastication has been used by Bob Brygider for a study of resilient denture lining materials. Soft lining materials which were treated on the surface with a solution of mono-methyl methacrylate/ and polymethyl methacrylate were found to undergo greater dynamic flow than materials

treated on the surface with a coating of poly vinyl chloride/methyl ethyl ketone solution which in turn was no different than the untreated materials. The coating of the surface of the soft polymer with the vinyl compound was found to significantly reduce the leaching of plasticizer during simulated mastication.

The dies used to make dental restorations should ideally be exact replicas of the prepared teeth. A study has been conducted to determine the dimensional accuracy of dies made from three different die materials, and four different types of impression materials. Ten dies were made from a metal master for each die-material/ impression material combination (120 total). Measurements were made in three directions on the dies. Differences were found between the various impression material and die material combinations. The dies were found to be consistently larger in all three directions measured compared to the metal master die. However, it was concluded by Richard Price and colleagues that the differences were not clinically significant.

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RESEARCH CONCLUSIONS

The review of a small section of our on-going research in the Faculty of Dentistry in the previous pages which hopefully will be accepted for presentation at the IADR meeting in Cincinnati, has one main common feature. In all cases the research will improve the general knowledge base in scientific dentistry and will lead to improvements in both our teaching programmes and ultimately the clinical service in dentistry. All of the faculty members staff and students involved in these research projects will be the richer for having participated in this research. To quote Robert Fournier once again, "Any organization which calls itself a university has an active, dedicated cadre of people researching and those same people are teaching. Researchers are people who really want to understand. For people who don't do this for a living, it is difficult to comprehend". It is clear having documented a small section of our on-going research submitted to the IADR for the meeting in 1990 that we have a dedicated cadre of researchers and the number is growing all the time.

However, what is also exciting about this is that the

quality of the research is also of a very high standard. Perhaps what is also of great importance is that the research covers such a wide range of subject material. Research activity in the Faculty of Dentistry is alive and well in 1989. The involvement of students in our research is also a very positive factor which holds out hope for the future of research in dentistry.

Statistical Precision

"Molecular science teaches us that our experiments can never give us anything more than statistical information, and no law deduced from them can pretend to absolute precision"

Maxwell

Why?

"In general, whenever we ask what anything is we are inviting confusion by throwing the doors open to all sorts of philosophical issues about which there has been notorious disagreement for the last three thousand years,"

P.W. Bridgman

The Last Word!

"Like Shakespeare's Gaunt, experimentalists know that they will be remembered for what they say last."

Peter Galison

NIDR Funding

In 1988 The National Institute of Dental Research (NIDR) in the US gave out a total of \$93,406,217 out of this \$86,687,314 was for research contracts, research grants, training grants, fellowships and research career awards. A total of 413 research grants were awarded to individuals in schools of dentistry for a total of \$35,328,298 at an average of \$85,540 per grant. The top eighteen institutions in terms of the number and value of dental research grants are shown in table 1. It is interesting to note that Suny Buffalo receive about the same funding as all of the ten Canadian dental schools put together.

Table .1.

Institution	#	Amount (\$US)
Suny Buffalo	26	4,908,358
Michigan	30	4,770,025
Forsyth Centre	23	4,317,614
Seattle	23	3,950,601
Pennsylvania	18	3,833,653
Alabama	23	3,661,862
North Carolina	39	3,307,401
San Francisco	20	3,259,389
Gainesville	18	2,836,382
Iowa	14	2,370,984
USC	14	2,109,389
Minesota	19	1,866,952
Connecticut	22	1,476,809
Rochester	10	1,441,273
Virginia	09	1,434,868
San Antonio	17	1,102,729
UCLA	09	1,099,826
Houston	09	1,089,107

The distribution of NIDR research grants for 1988 amongst the various states in the US is also shown in table 2.

Table 2.

State	# Grants
Alabama	34
Arizona	01
California	70
Colorado	07
Connecticut	31
Delaware	02
District of Columbia	14
Florida	26
Georgia	35
Hawaii	01
Illinois	42
Indiana	20
Iowa	18
Kansas	02
Kentucky	06
Louisiana	15
Maryland	46
Massachusetts	75
Michigan	38
Minnesota	27
Mississippi	07
Missouri	23
Nebraska	06
New Jersey	12
New Mexico	04
New York	94
North Carolina	54
North Dakota	01
Ohio	29
Oklahoma	02
Oregon	05
Pennsylvania	47
Rhode Island	01
South California	05
South Dakota	01
Tennessee	07
Texas	50
Utah	03
Vermont	01
Virginia	13
Washington	35
West Virginia	01

New York is top with 94 followed by Massachusetts with 75 and California with 70. Canada is top of the 9 non-US foreign grant holders with a total of five grants. Two at McGill and three are at Toronto.