Dalhousie University, Faculty of Dentistry

SPECIAL EDITION
NOVEMBER 1990

Dental Research News

Research Development Office, (902) 424-1675

VOLUME IV, NUMBER 11.

This months edition is dedicated to the many members of staff and faculty who have worked so hard during the past several months in the preparation of abstracts papers and research grants for submission. Special thanks are due to the dedication of Dr. Barbara Harsanyi who worked diligently in writing abstract and publication material at a very difficult time just prior to and after her recent surgery.

High Research Productivity

The number of abstracts being submitted to the IADR from the Faculty of Dentistry at Dalhousie University is again very impressive. The total of 18 abstracts is quite astonishing for the small size of our faculty. Unquestionably we have an established climate which is conducive to research and academic pursuits. However, 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 additional work, and is in many cases only a preamble to a full publication in a refereed journal or the submission of a research grant proposal. One encouraging aspect of this years IADR papers submitted is that six of these will receive travel support from external funds.

As was the case last year this Months Dental Research News is a **Special Edition** which features coverage of some of our on-going research in the Faculty based upon the submission of **20** abstracts to international meetings in 1991.

Hectic Period

The past few weeks have been rather hectic with the final preparations for the submission of the research grant applications to NHRDP and to MRC. Two renewal grants were submitted to the federal agencies for the November 1st deadline. The one to NHRDP was a longitudinal clinical study dealing with the influence of flouride on dental caries. The MRC Programme Grant involves the synthesis of inorganic and organic biomaterials together with their evaluation and drug release from biomaterials.

Biomaterials MRC Grant Renewal Application

In the 27. months since funding was first provided for our MRC Programme Grant, the following major achievements have been completed:

1) Development of new improved biocompatibility evaluation methods for tissue irritation and cytotoxicity testing.

2) Development of the first 8-component feldspathic glass by the sol-gel method for porcelain application.

3) Determination of the first 18 month leachability profiles for soft polymer-gel biomaterials.

4) Determination of the mechanism limiting K^+ in the network of feldspathic glass systems.

5) Development of a unique ceramic filler for composite materials produced by wet chemistry.

6) Development of a room temperature photopolymerizing technique for the production of low Tg polymers.

7) Determination of the efficiency of plasticizers relative to specific methacrylate polymers.

8) Synthesis of ion-leachable ceramable glasses by wet chemistry which react with poly (acrylic acid) to form cements.

9) Determination of the influence of polymer-gel/drug interaction on the drug diffusion profiles.

Further significant progress has also been made in the development of techniques for ceramics glass and polymer synthesis. The refinement of rheological, ultrasonic and fracture toughness methods has made significant progress. During the period of funding for the grant a total of 39 different papers have been presented (March 1989-June 1990) at international and national biomaterials society meetings, and the International Association for Dental Research (IADR) meetings. A further 11 abstracts have also been submitted for IADR and biomaterial meetings in 1991. A total of 13 papers have been either published, accepted for publication or submitted during this period. In addition, a further nine papers are in the final stages of completion for submission. Since the funding awarded for this programme grant was less than our budget request, a reduction in the scope of the projects was implemented. One major problem was no funding for a furnace for our Project dealing

(Cont on Page 3)

(Cont from Page 2)
with glass synthesis. However, a significantly revised research plan and acquisition of an MRC Major Equipment Grant in 1989 for $18,333 permitted the purchase of a much less expensive furnace, which allowed a limited version of the original work to proceed. The initial period was spent setting up our chemical synthesis laboratory in refurbished space allocated for the purpose. Five technical personnel were hired and trained during the first six months. Some equipment delivered in September and December of 1988 were plagued with malfunction problems, causing significant delays in our research. Our failure to obtain funding for a scintillation counter was unfortunate since we have only limited access to a very old and temperamental machine in the Faculty of Health Professions. In spite of these complications, the progress of the work has moved along well and projected milestones have been achieved. The research team have worked very hard during the first term of the grant. This was especially true during the hectic period which involved writing abstracts and papers and the final putting together of the grant application.

New Image

The MRC Biomaterials Programme Grant has taken on a new image with an expanded number of investigators, increasing from 8 to 11. Joining the team will be Dr. Jurgen Kreuzer from the Department of Physics at Dal and Dr. David Pink from the Physics Department at St FX. Another new face on the team will be Dr. Eva Butler from the Collage of Pharmacy. In addition the team will be strengthened by the inclusion of Dr. Mike Gross an orthopedic surgeon from the VG. Missing from the line-up will be Dr. Jan Kwak who has had to step down due to administrative duties as Chairman of the Chemistry Department. However, the good news is that Dr. Kwak will continue as a consultant to the programme. The remaining members of the team are Dr's Foong, Graham, Mezie , Harsanyi, Howell, Sutow and Jones. The Programme budget request for the next 5 years is for $2.84 million.

Bacon Bits

"Knowledge is power and the aim of science is the production of the means".

Francis Bacon.

SCIENTIFIC THEORY

"I equate the acceptance of a scientific theory with the belief that it is empirically adequate"

Bas van Fraassen.

NHRDP Grant

The grant renewal submitted by Dr. Amid Ismail with his colleagues is titled: "Evaluation of the Restorative Treatment Services of the Quebec Children's Dental Insurance Program": This grant covers the period 1991-1993; and has a budget of $120,080. The coinvestigators with Dr. Ismail are Dr. Pierre Gagnon, Laval University, Dr. Martin Payette, Hopital St-Luc, Dr. Brian Eastwood, Dalhousie University, and Dr. Marie Olivier, Laval University who is a new member of this team.

This renewal application is for the third and fourth years of funding for a longitudinal study funded by NHRDP in 1989, to investigate the following objectives: (a) to determine the variability of decisions regarding restorative treatment needs, (b) to ascertain whether tooth surfaces with incipient lesions (noncavitated carious lesions) are restored rather than sealed or followed without treatment, (c) to determine the rate and quality of replacement restorations in children in Montreal. During the 18 months of funding the investigators achieved all of the planned activities: sampling of 911 children in grades 1-3, development and testing of examination criteria, pilot study and coordinating of data transfer with the Quebec Health Insurance Board (RAMQ). Baseline data collection commenced in March, 1990, and was completed in May, 1990.

Much More Than Knowledge.

"Science is a way of thinking much more than it is a body of knowledge. Its goal is to find out how the world works, to seek what regularities there may be, to penetrate to the connections of things - from sub-nuclear particles, which may be the constituents of all matter, to living organisms, the human social community, and thence to the cosmos as a whole".

Carl Sagan

SMILE

Research Definitions

"A sampling error occurred" means, we didn't get the answer we wanted.

"We didn't get the answer we wanted" means, the negative control gave a positive result.

"The positive control gave a negative result" means, I will not get tenure this year.

The following research report is based upon the abstracts which have been forwarded to the IADR and the Biomaterials meeting during the past few weeks. The research represents only part of the on-going research in our faculty. Many other research projects are also on-going which are not included. Recognition should be given to the students who have participated in our research during the past summers which has resulted in abstracts being submitted to international meetings.

Inhibition of Tooth Enamel Demineralization: Dr Tom Boran has been collaborating with Ken Zakariasen in research designed to shown that the use of laser irradiation treatment of enamel can inhibit subsurface demineralization typically seen in carious lesion progression. A study was conducted using a revised methodology from previous research. The study compared two levels of CO_2 laser irradiation for its demineralization inhibitory effect on smooth surface enamel. Eighteen extracted third molars were selected and each tooth was covered with acid resistant varnish except for three windows on the buccal surface which measured 1.0 mm in width and length, two windows being experimental, the third control. One experimental window was lased with 1.5 watts the other 2.5 watts, both @ 0.15 sec with a 1.5 mm focal spot. All teeth were demineralized in ten Caté solution (2.2mMCa^{++} and PO_4, 50mM acetic acid, 5 ppmF @ constant pH=4.3) for 12 days. The resulting lesions were sectioned and examined by polarized light photomicrographs. Black and white photo enlargements were made and the lesion areas were quantified with a planimeter. The data was analyzed by ANOVA and Duncan's Multiple Range Test. Both power levels resulted in significantly smaller zones of demineralization than observed in the controls ($p=.05$), however, no significant difference was found between the two power levels. Under the conditions of this study, low levels of CO_2 laser irradiation appear to have an inhibitory effect on enamel subsurface demineralization.

Airpolishing of Restored Teeth: Dr Crawford Bain and colleagues have evaluated the effects of 'air polishing' using an aqueous slurry of $NaHCO_3$ on restorative materials.

(Cont on Page 6).

(Cont from Page 5)
The concept of air polishing tooth surfaces has developed in the last decade. While the effects of airpolishing on enamel, cementum, dentine and gingiva have been examined, little information is available on its effects on restorative materials. This *in vitro* study was conducted to examine the effects of the 'Prophyjet' on 4 composite resin systems. Samples of each were prepared on standardised glass slabs and divided into 3 sections. The central section, used as a control, was protected by a mylar strip. The left and right sections, used as test sites, were treated by the 'Prophyjet' and rubber cup respectively for 30 secs. 3 samples of each material were measured at 5 sites using a surface profilometer. For each composite material a greater surface roughness was found for sites treated by airpolishing than either the rubber cup or control sites. In every instance these differences were statistically significant. Care should clearly be taken when using airpolishing on teeth restored with composite resins.

Polishing Dental Alloys: Many methods have been advocated for polishing dental casting alloys. A study has been conducted by Dr. Gormon Doyle and colleagues comparing two conventional methods and one customized method. The three different polishing methods were examined for effectiveness using three dental casting alloys. The polishing methods were based upon different polishing pastes, abrasives and instruments. The casting alloys used were: Type III gold, high gold content ceramo-alloy and a copper aluminum alloy. Test specimens were flat, 12 mm diameter disks. Each disk was air abraded with 25 micron aluminum oxide following removal from the investment mould. Results showed that for Type III gold significant differences were found 19/20 times between Method 1 and Methods 2 and 3 but only 1/10 times between Methods 2 and 3. For the ceramo-alloy significant differences were found 17/20 times between Method 1 and Methods 2 and 3 and 6/10 times between Methods 2 and 3. For the CuAl alloy significant differences were found 15/20 times between Method 1 and Methods 2 and 3 but only 2/10 times between Methods 2 and 3. The high gold content ceramo-alloy in general had the poorest surface finish and was the most difficult to polish. Method 1 was the most efficient polishing method.
(Cont on Page 7)

(Cont from Page 6)

Mercury Health Hazard: Mercury vapour released from improperly stored amalgam scrap and waste mercury can present a serious health hazard in the dental office. Many of the studies conducted to determine effective storage media have limitations in experimental design or lack of statistical validation. A study was conducted by Dr. Elliott Sutow and colleagues to examine the capacity of selected liquid storage media to suppress mercury vaporization. Three liquids were selected for the study: Fresh Photographic Fixer; Used Photographic Fixer; and a commercial product, Merconvap. Type I water (18 Mega ohm) was used as a reference. Mercury drops (0.287 g) were placed in 60 mL vials containing 10 mL of a test liquid (n=5). The vials were then tightly capped. The caps were temporarily removed for the thirteen controlled measurements which were taken during a 9 day period, using a Bacharach Mercury Vapor Sniffer. Removing a cap simulated dental personnel placing additional amalgam scrap or waste mercury in a storage container. Measurements were made above mercury drops (n=5) with no liquid coverage. Additional measurements were conducted on the liquids with no mercury present, to determine background error. Testing was conducted at 21.1-22.8°C. The data were analyzed using a Student-Newman-Keuls multiple comparison test ($p = 0.05$). Results showed that all four liquids substantially suppressed mercury vaporization compared with no liquid coverage. From 2.75 hours to 9 days, mean mercury concentrations above the three selected liquids showed no statistical difference and were well below the Threshold Limit Value of 0.05 mg/m^3 (TLV), but were different from the values above water, which exceeded the TLV after approximately 4 hours. It was concluded that any of the three selected liquids may be used to substantially suppress mercury vaporization from amalgam scrap and waste mercury.

Composite Materials: In the MRC Biomaterials Programme we have been developing experimental composite systems. However, we also need to evaluate the properties of commercial materials for comparison. We have recently compared the Timoshenko disc breaking strength of one posterior and two anterior commercial composite materials. The materials evaluated were P50, Silar and Silux+.

(Cont on Page 8)

(Cont from Page 7)
Comparisons were also made between these results and dynamic Young's, shear moduli and Poisson's ratio values obtained using an ultrasonic wave technique. All values were significantly different for the three materials ($P< 0.05$). The modulus and shell strength values of the posterior (P50) composite were 46-63% higher than for the anterior composites. The Poisson's ratio of the posterior composite was between 25-29% lower than for the anterior composites. The coefficient of variation for the dynamic tests was significantly lower (0.7 to 1.75) compared to the shell strength test (8.56 to 17.99).

Ion leachable glasses: Glass polyalkenoate cements which bond to calcified tissues are finding increasing use as biomaterials. Although the first patent for these materials was taken out as long ago as 1973, significant potential remains for development of improved materials. Our biomaterials group are working on the development of improved new formulations for these materials. As part of our MRC programme we have recently synthesized a range of ion leachable glasses (SiO_2-Al_2O_3-CaF_2-$AlPO_4$-AlF_3-NaF) capable of reacting with carboxylic acids to form cements. The glass formulations are also designed to undergo crystallization during slow cooling or heat treatment. The precursor materials for these formulations were synthesized by a wet chemical method. Various amounts of fluoride and sodium were incorporated to act as either flux or nucleating agent. Precursor powders for the glasses were synthesized from colloidal suspensions of Al_2O_3, SiO_2, H_3PO_4 and nitrates of calcium and lithium by spray drying, calcined at 1000°C, and mixed with Ca, Al, and Na fluorides. Following calcination, the glasses were melted at 1600°C and rapidly cooled to produce a clear glass. The Ca in the final glasses varied from 10.64 to 20.03% and the Al from 15.64 to 20.53%. Compositions of 7 glasses were significantly different ($P=0.05$). Glass powders ($<40\mu m$) were blended with freeze dried polyacrylic acid (mol wt 23,000) and an aqueous solution of tartaric acid. The bulk chemistry was determined by AAS following digestion with HF. UV spectroscopy and an ion specific electrode were used to determine the P and F contents, respectively. The setting characteristics were determined by means of an oscillating rheometer. Cements
(Cont on Page 9)

(Cont from Page 8)
of various reactivities resulted when the ion leachable glass formulations when mixed with PAA/tartaric acid. The chemical interaction between polyacids and the ion leachable glasses is being customized aiming to provide optimal clinical manipulation and performance.

A cyclic torsion rheometer device has been developed which is capable of characterizing the rigidity of the setting cement materials. This device has been used to determine rigidity during setting at 37 ± 0.5°C. The essential component of the test system is a cantilever beam through which a torque is applied across the faces of a cylindrical sample. the system is designed to give minimal disturbance to the material under test. In the fluid state, of the cement, the rate of displacement at the circumference of the specimen has a velocity of 1μm/sec. The lower platen is attached to a very low friction precision ball race bearing, the upper platen is fixed. Both platens are heated by a water jacket to 37°C and have parallel grooves cut to aid in sample retention. A synchronous motor operates through a step down gear and an eccentric cam producing a cyclic movement of 0.05 Hz. The angle of movement at the test specimen is approximately ± 0.12 of a degree.

The glass formulations were mixed with five different glass polyacid ratios. The glass/acid ratios ranged from 3.3 to 5.5 for the different materials. Individual optimal (constant) amounts of tartaric acid and p/L were used for each glass formulation. Tartaric acid for the individual materials ranged from 12-20%. Rigidity of cements was determined using the torsion rheometer and compared at 10 and 20 minutes.

The effect of variation in polyacid glass ratio had a significant effect on the rigidity of the cements for all glass materials. The tests were able to clearly distinguish between the rigidity of the different glass polyacid ratios. Higher glass polyacid ratios produced significantly greater rigidity for the various glass formulations ($p < 0.05$). The chemical composition of the glass significantly influenced cement rigidity at 20 minutes for 5 out of 7 formulations. Lower Ca and Al in glass formulations gave significantly lower rigidity. Following further studies it should be possible to derive fundamental properties from the rheological data provided by the cyclic torsion instrument

(Cont on Page 10)

(Cont from Page 9)

Crystallization of Experimental Glass: An objective of recent work has been to determine the phases and activation energy during crystallization heat treatment for glass compositions produced by wet chemical synthesis. The different glass formulations crystallized during heat treatment producing glass-ceramics with various degrees of opacity. Crystallization kinetics were studied by means of DTA. Samples of each glass were heated from 23 to 1200°C under a N_2 atmosphere at heating rates ranging from 5 to 50°C/min. The activation energy of crystallization for each composition was calculated from an expression relating log heating rate and the reciprocal of the exothermic peak temperature. The compositions of the glasses were significantly different ($p=0.05$). The activation energy values ranged from 61.17 to 183.11 Kcal/mole. X-ray diffraction of the heat treated glasses showed the presence of three distinct crystalline phases, Gehlenite, Anorthite and Fluorapatite. Different ratios of these three phases were found in each of the compositions.

Purpose: "Research demands equipment and technique: it also demands an inner purpose." John Ziman

Simulation of Fluoride Diffusion: Dr. David Pink of the Physics Department of St FX has now joined our MRC Biomaterials research group. A recent collaborative study has been undertaken in which a 3-dimensional computer model of a glass ionomer cement was developed and studied using the Monte Carlo method. The objective of the study was to calculate the theoretical F^- diffusion and compare it with *in vitro* F^- diffusion data obtained previously (Abst#672 IADR 1988). In the model diffusion coefficients were temperature-dependent and F^- moved randomly and were removed when crossing the unit cell boundary. F^- diffusing from the glass began to contribute unambiguously to the total diffusion when t = 200 Monte Carlo steps. The simulation data showed diffusion to be approximately linear with $t^{1/2}$ up to ≈10% loss of F^-. Very good agreement was obtained between 12 month *in vitro* F^-diffusion data and the theoretical model. Extensions of the model will enable a study of mechanisms and predictions of F^- release profiles for synthesized glass ionomer cement systems having different fluoride concentrations.

(Cont on Page 11)

(Cont from Page 10)

Cytotoxicity Test: As part of our MRC programme we have previously reported a liposome-neutral red *in vitro* cyto-toxicity test (Howell *et al.*, 1989, IADR). However, NIH 3T3 fibroblast may be an inappropriate cell line in cytotoxicity testing. In a recent study Dr. Foong and colleagues have compared the use of NIH 3T3 and L929 fibroblast cell lines to evaluate the cytotoxicity of methacrylate monomers [Methyl MA (MMA), Butyl MA (BMA), Ethyl MA (BEMA) and Lauryl MA (LMA)]; phthalate esters [diethylhexyl phthalate (DEHP), Dibutyl phthalate (DBP); butyl benzyl phthalate (BBP)] and dibutyl sebacate (DBS). The concentration effect of liposome entrapped compounds on the neutral red (NR) content of either type of fibroblast cells was measured spectrophotometrically. Ten-fold dilutions of liposome entrapped compounds incorporated in culture media gave six concentrations (n=6) of 10 mM to 0.1 μM for each compound. Liposome entrapped dibutyl tin diacetate (DBTD) was the positive control. No difference was seen between negative controls (CONT): DMEM, PBS and "empty" liposomes (p=0.380). NR absorbance at all test sample concentrations was less toxic then the positive control. There was no significant difference between the sensitivity of NIH 3T3 or L929 fibroblast cells with all compounds tested. It was possible to conclude that NIH 3T3 and L929 fibroblast exhibit similar sensitivity using our liposome-neutral red in vitro cytotoxicity test.

Biocompatibility:

Dr. Barbara Harsanyi together with MRC group colleagues has been evaluating tissue reaction to denture soft polymer-gels containing dibutyl phthalate (DBP). Four subcutaneous (SC) implant sites in the backs of each guinea pig (n=6) were used. Three sites were implanted with either the negative, test or positive control (PC) polymer discs (4 mm dia. 2 mm thick). The fourth site contain no implants (sham operated). Specimens were produced by blending polymer with ethanol (EtOH), which was evaporated at 37°C, 24 hrs prior to implantation. DBP or dibutyl tin diacetate were incorporated into the test and PC soft polymer-gels respectively. Control polymer discs (PD) contained no plasticizer. Animals were killed seven days after implantation. The gross and microscopic tissue reactions at each implant site were evaluated.

(Cont on Page 12)

(Cont from Page 11)
No significant differences were observed between the groups in inflammation of remote dermis, SC tissue or muscle. Positive controls produced a severe peri-implant reaction with extensive necrosis and acute inflammation. Test and PD showed a less intense reaction with less necrosis and an infiltrate predominantly composed of macrophages. Sham operated sites showed mainly fibrous repair with much less inflammation. Peri-implant inflammatory intensity associated with test and PD was significantly different ($P<0.01$, RIDIT analysis) from PC or sham operated sites.

Plasticizer Efficiency: In our Biomaterials Programme Grant research we have previously reported qualitative and quantitative plasticizer leachability from 8 commercial soft polymer materials. Data shows dibutyl sebacate to have the lowest leachability compared to other plasticizers. The objective of the present study was to determine the glass transition temperature (Tg) of 8 commercial soft polymer-gel denture lining materials as well as unplasticized homopolymers of ethyl and methyl methacrylate, and to establish the efficiency of plasticizer constituents. The commercial materials studied were 100% poly(eythyl methacrylate) or copolymers with 1-21% methyl methacrylate. Specimens were made and aged for 24 h. A liquid nitrogen cooled Thermomechanical Analyzer was used to determine the Tg's. The values for the commercial materials ranged from -13.16 ± 1.93 to -26.23 ± 1.28°C. The Tg's for the homopolymers were PMMA 114.3°C, and PEMA 67.9°C. The effectiveness of the plasticizers was determined based upon known polymer compositions of the commercial polymers determined previously. A Student-Newman-Keuls rank order test separated data into 5 groups ($p= 0.01$). We were able to establish that to reduce the Tg of a PEMA/PMMA copolymer by 100°C the following amounts of plasticizer would be required: DBS 28.4%, DBP 36.9%, BPBG 44.6%, BBP 51.0%, BB 56.1% and BS 56.6%. It was concluded that DBS was the most efficient plasticizer, while BB and BS were the least efficient.

Soft Polymers: In our MRC Biomaterials Programme Grant research we have been aiming to develop low glass transition temperature (Tg) polymers. A unique room temperature suspension photopolymerization method has been developed. (Cont Page 13)

(Cont from Page 12)
This method has been used to synthesize soft methacrylate polymers. In this technique 6% gelatin solution is stirred at 504-720 rpm, together with a constant %(w/w) of camphorquinone, N,N,3,5-tetra-methylaniline and lauroyl peroxide. A N_2 gas purge is made prior to incorporating ethyl and lauryl methacrylate monomers and at intervals during reaction. The chemical composition of the resulting polymer was determined by pyrolysis/GC. A 50-78% yield of polymer beads was obtained all <149µm with 23-48% <63µm. The copolymer beads were blended with EtOH and DBP/BPBG plasticizer combinations using various ratios to form polymer-gels. Copolymers of lauryl methacrylate and ethyl methacrylate were found to have Tg's of between 21.77 and 67.9°C. Tg's of plasticized copolymers ranged from -44.2 ± 1.35 to -9.9 ± 1.02°C. With 41% plasticizer present it was found that increasing lauryl methacrylate from 10-20% in the copolymer lowered Tg by 5.64°C. A Tg of -21°C was obtained using 22% less plasticizer for an experimental 10% lauryl methacrylate/90% ethyl methacrylate polymer compared to a commercial material.

Root-Canal Research: An ultra-sonic method is often used to obtain "flared" root-canal preparations. An *in vitro* research study by Ken Zakariasen and colleagues has compared canals prepared by a modified sonic technique versus preparations carried out using hand files. 48 Endodontic practice blocks were accessed and randomized into 4 groups and treated using different instrumentation. Three examiners evaluated the *in vitro* root canals (random blind design) for apical transportation, ledging and formation of an "hour glass" canal shape. No sig. difference ($p = .05$) was found amongst the groups and none of the four techniques demonstrated problems with regard to these criteria. However, 7 of 12 canals prepared by K-files exhibited canal blockage with filings which did not occur in the other 3 groups. Under the conditions of this study, the modified sonic technique is comparable to step-back filing with regard to frequency of apical transportation, ledging and "hour-glass" canal distortion, all techniques being acceptable for these criteria. However, it was observed that the modified sonic technique was the most rapid and easiest to accomplish.

(Cont on Page 14)

(Cont from Page 13)

Corrosion Behaviour of Endodontic Device: Elliott Sutow has been working with Sheldon Best and colleagues to evaluate a new device for obturation of root canals. The device is composed of a stainless steel shaft encased in gutta percha. The alloy compares with Type 302 stainless steel, but has Mo (0.8% max) added for corrosion resistance. The stainless steel shaft remains in the root canal following normal tooth restoration. In the absence of an apical seal, to the root, corrosion of the shaft is potentially a biocompatibility problem since stainless steel is susceptible to crevice corrosion. Also, migration of any solid corrosion products can stain tissue. It was the objective of this study to evaluate the *in vitro* corrosion behaviour of the shaft under simulated physiologic conditions. After removal of the gutta percha, the shaft was subjected to two corrosion tests in 0.9% phosphate-buffered saline solution (pH=7.2), at 37°C. Test 1: placement of a shaft (n=15) in prepared endodontic practice plastic blocks, with no seal provided during placement. Test 2: mounting of a shaft (n=15) in clear resin and finishing (600 grit SiC) longitudinally to produce a flat surface which was placed against a glass slab. One specimen was removed from solution every two weeks, giving a total of 30 weeks immersion. Specimens were examined for indications of corrosion, using a light microscope. Negative and positive controls were iron and Type 316 stainless steel wires, respectively. Results for the iron control showed early and severe corrosion, with the presence of copious amounts of rust. There was no evidence of corrosion products or pitting of the stainless steel control. For Tests 1 and 2, the shafts showed no evidence of corrosion products or pitting along the tapered, spiral or cylindrical portions. It was concluded that under static, occluded conditions, the shaft did not crevice corrode during the period of testing.

Clinical Research: Joey Barron has been helping to solve an electronic problem for Dr's Zakariasen and Gerrow. The measurement of pH levels *in vivo* is quite a difficult procedure. A major problem is electronic noise which can be induced into the transducer leads by patient movement. It is thus important to minimize movement during intraoral plaque pH studies and, given current pH transducer systems, it is impractical to use an

(Cont on Page 15)

(Cont from Page 14)
epidemiologic approach in which subjects go about their normal activities. This problem can be reduced by either, filtering or impedance transforming. A study of the effects of both filtering and impedance transforming on pH recordings when the patient was sitting quietly or walking was undertaken. Multiple intraoral pH measurements for the same patient were made using pH electrodes with either pH electrometer or differential circuits. 28 trials were run with the following comparisons: sitting vs. walking, filtered vs. unfiltered, and field effect transistor (FET) vs. no FET. Each trial involved 4.5 min. of pH recording. This research has shown that if wire telemetry is to be used for intraoral glass electrode pH studies where patient movement is expected, filtering, field effect transistors or a combination should be considered.

Orthodontics: Post-adjustment discomfort from orthodontic appliances is quite common. Some reports have indicated that masticatory function may ease discomfort. Dr. Bill Lobb and colleagues have designed a research study to determine the discomfort patterns, medication use, and effects of chewing gum following orthodontic adjustments, as well as whether a sugarless, non-stick gum would adhere to fixed appliances. 16 patients fitted with orthodontic brackets were randomized equally into control and gum-chewing groups. All had appliance adjustments 24 to 48 hrs. prior to the study. Subjects were requested to record discomfort levels on a visual analogue scale every 15 min. for a 4 hr. period. During hour two, the experimental group chewed gum continuously. All subjects also recorded their adjustment time, peak discomfort period and medication use. All 16 subjects reported post-adjust. discomfort, 15 out of 16 claimed the maximum discomfort within 18 hrs. 2 out of 16 reported the use of analgesics. These drugs were taken at least 24 hrs. prior to the study. The control group showed no change in discomfort level during hour two. In the experimental group, 3 patients recorded less discomfort when chewing, 2 recorded more discomfort, and 3 recorded no difference, the "no difference" group having no pain at the beginning of the study (i.e. post-adjustment. discomfort had peaked and returned to "0") and reporting none on chewing. 7 of 8 reported no adherence of gum to appliances. The initial data
(Cont on Page 16)

(Cont from Page 15)
reported by this group indicates that post-adjustment. discomfort may occur frequently, peak relatively quickly, and leads to infrequent analgesic use. It would also appear that gum chewing may have a beneficial role for some patients as a coping strategy and may be used without adhering to appliances.

Post-Surgical Infection:
The potential role of infection in hemorrhage following maxillofacial surgery (LeFort 1 Osteotomy), has been investigated by Dr. Precious and colleagues. Potentially life-threatening epistaxis occurred during 7-10 days following LeFort 1 osteotomy in eight patients all of whom demonstrated the presence of klebsiella microorganisms in the oral-nasal culture specimens taken at the time of bleeding. An investigation was conducted to determine the presence of klebsiella species, either with or without prophylactic antibiotic coverage, in 43 patients who underwent correction of dentofacial deformity using LeFort 1 osteotomy. Forty-three consecutive patients who underwent at least LeFort 1 osteotomy were randomly assigned to one of two groups: Group 1, 21 patients, received immediate pre-operative penicillin G, 1,000,000 IU, iv. and post-operative penicillin G 500,000 IU iv., q6h for one day then penicillin V 600 mg. p.o., q6h to the tenth post-operative day. Group 2, 22 patients who received no antibiotic coverage. Aerobic swabs were taken from both the buccal vestibule opposite the maxillary first molar and the region of superior meatus of the nose, 1 day pre-surgery and 2 and 10 days post-surgery. Klebsiella species were not identified in pre-operative specimens from any of the 43 patients. In Group 1, klebsiella was identified in 8 patients by the tenth post-operative day. In Group 2, klebsiella was not identified. Comparing the incidence of klebsiella presence in the two groups using Fisher's exact test, $P=0.001$ showing strong evidence that the two groups differ with respect to identification of klebsiella. The researchers were able to conclude that, perioperative penicillin which is administered intra operatively and for ten days post-surgery carries with it the risk of development of post-surgical presence of klebsiella species. Since these klebsiella organisms have been found in patients who have had severe epistaxis following LeFort 1 osteotomy.

Dentistry in the Year 2000?

We often try to consider what will be the needs of dentistry in the future. This will significantly affect the way in which we educate our students. Many of our first year class of September 1990, could be practicing dentistry in the year 2,050. One aspect which is neglected when we aim to project changes in dental treatment and procedures is the the non-dental research which can impact upon scientific of dentistry.

One such example is the use gene-splicing. Recently U.S. scientists have been given the go-ahead to use gene-splicing for the first time to treat a severe genetic disease in children that prevents their bodies from making a key enzyme.

An advisory committee of the U.S. National Institutes of Health, given the go-ahead for the first transplant into humans of genetically altered cells for a therapeutic purpose.

The scientists propose removing a type of white blood cell from affected children, inserting a functioning human gene and then returning the cells to the patients. Scientists have conducted human genetic engineering on a handful of patients, but not for a therapeutic purpose.

Researchers have marked blood cells by inserting a gene from a mouse virus into them in order to track them in the body. Genetic engineering, which until only recently was the stuff of science fiction, is now slowly changing the face of farming, medical health care and who knows, one day dentistry?

Dire predictions that fiddling with genes inside living organisms would lead to ecological disasters or even worse Nazi-like attempts to alter human beings, the result so far has only been a growing number of commercial products.

To-date very little genetic engineering has been performed on humans, however, it is now under-way.

Genetic engineering is creating new ways to develop drugs and new ways to test them in custom-tailored laboratory animals. The genes of plants, animals and bacteria are now routinely spliced together in laboratories around the world. Who knows what the future has in store for dentistry?

Not Quite But Almost

Charles Darwin wrote in 1844 after more than ten years of painstaking labour in the gathering of relevant facts "At last gleams of light have come and I am almost convinced".

ACAPULCO ABSTRACTS

The following 17 abstracts have been submitted to the 1991 Acapulco IADR meeting. In addition Crawford Bain has also submitted an abstract bringing the total to 18. Two further abstracts have also been submitted to the May 1991 Biomaterials meeting.

Reducing Noise in Intraoral pH Telemetry. **J.R. BARRON***, K.L. ZAKARIASEN, J.D.GERROW, C.G. HOLMES, K.A. ZAKARIASEN.

Corrosion Evaluation of an Endodontic Filling Device. E.J. SUTOW, K.L. Zakariasen, **S.A. BEST*** and D.W. JONES.

The Effects of CO_2 Laser Radiation on Smooth Surface Enamel In Vitro. **T. L. BORAN***, K.L. ZAKARIASEN and J. PETERS

Effects of Air Polishing on Various Composite Resin Systems. C.A. BAIN, M.E. MADER and **L.M. DE LOREY***.

Effectiveness of Three Different Polishing Methods on Dental Casting Alloys. **G. DOYLE***, E. SUTOW, A. RIZKALLA and M. GILLIS.

Comparison of an *In vitro* Cytotoxicity Test Using Two Cell Lines. **W.C. FOONG***, M. CHIAROT, P. HIDI, D.W. JONES, and R.E. HOWELL.

White Light Synthesis of Low Tg Methacrylate Polymers, D.W.JONES, **G.C.HALL***, E.J.SUTOW, and D.R.HILCHEY

Subcutaneous Implantation of Denture Soft Polymers. **B.B. HARSANYI**, W.C. FOONG, R.E. HOWELL, P. HIDI, D.W. JONES.

Synthesis of Experimental Ion Leachable Glass Materials. A.S. RIZKALLA, **D.W. JONES***, E.J. SUTOW and G.C. HALL.

Mechanical Properties of Three Commercial Composite Materials, D. W. JONES, G.C. HALL, **C. JOHNSON***, A. S. RIZKALLA & E. J. SUTOW.

Orthodontic Post-Adjustment Discomfort Patterns and Gum-Chewing. **W.K. LOBB***, K.L. ZAKARIASEN, P.J. MCGRATH, K. A. ZAKARIASEN, C.G. HOLMES

Comparing Canals Prepared by a Modified Sonic Technique and Step-back Filing. K.L. ZAKARIASEN, and **S.M. MACLEAN***

Simulation of Fluoride Diffusion from Glass Ionomer Cement, **D.A.PINK***, D.W.JONES, W.C.FOONG and B.E. QUINN.(St Francis Xavier and

---

Mercury Suppression By Various Liquid Media. E.J. SUTOW, W.C. FOONG, A.S.RIZKALLA, D.W. JONES and **N.L. POWER***

The Potential Role of Infection in Hemorrhage Following LeFort 1 Osteomy, **D. PRECIOUS**, R. GOODDAY, F. SKULSKY and C. FIELD.

Abstracts Cont on page. 19

Abstracts Cont from p. 18

Efficiency of Plasticizers in Lowering the Tg of Methacrylate Polymers, D.W.JONES, G.C.HALL, **E.J.SUTOW***, & D.R.HILCHEY

Crystallization of Experimental Glass Cement Forming Systems. **A.S.RIZKALLA***, D.W.JONES, H.W.KING, E.A.Payzant & E.J.SUTOW

==========

The following two papers have been submitted to the 17th meeting of the Society for Biomaterials, Scottsdale, Arizona, May 1-5th 1991.

Setting Rigidity of Experimental Glass Polyalkenoate Cements. **D. W. JONES***, A. S. RIZKALLA, J. DWYER, E. J. SUTOW and G. C. HALL

Influence of Composition of Methacrylate Copolymers on Mechanical Properties. **J. A. JOHNSON***, and D. W. JONES.

==========

The Search for Knowledge

"Teaching, research, and public service will be developed as expressions of a single, unifying purpose, the search for and application of knowledge"
Nils Hasselmo, President
University of Minnesota.

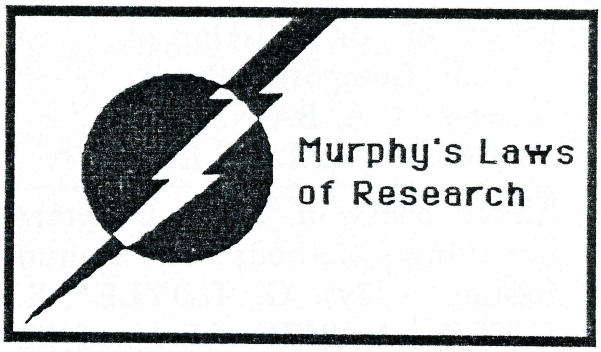
==========

Progress

Behold the Turtle. He makes progress only when he sticks his neck out. - James B. Conant.

$3.36 million Request.

Our Faculty have started the new decade well in terms of grant applications to federal agencies. A Development grant application has been submitted to MRC for our new microbiologist faculty member Dr. Haroun Shah who will be joining us next July. Dr. Amid Ismail has submitted his renewal grant to NHRDP. The MRC Biomaterials Programme Grant renewal makes up this excellent trilogy of applications. The total funding requested for these three programmes is $3.36 million. The arrival of Dr. Shah will round out our research base, providing us with a well balanced research programme.



16) The day you solve the problem you read the same result in a journal.

17) Researchers only see things with clarity when they are reviewing other scientists work.

==========