



Stimulus & Challenge

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Health Research Funding

Dr. James Wood visited Dalhousie University September 19th-23rd to discuss current funding trends in Biomedical Health Research. An open forum was held in the IWK Auditorium on September 19th, this was attended by three faculty members from Dentistry. During the week Dr. Wood met with a cross section of biomedical researchers at Dalhousie and in the hospital sector. Dr. Wood a biochemist from the University of Saskatchewan is using his sabbatical year to prepare a report on the distribution of biomedical research funding provided to selected universities. His analysis involved comparisons of the share of funding obtained compared to the percentage of the population. In his analysis he combined the provinces of Newfoundland, Nova Scotia and Saskatchewan which together have 9.4% of the total Canadian population. This indicated that Atlantic Canada (excluding N.B.) received typically 5-6% of the MRC funding (1990-94) and some 2-2.6% of NCIC funding. In contrast for the Heart and Stroke Foundation Atlantic Canada received between 8.3-9.6% of the funding, close to the proportion of the population. The reason for this is thought to relate to the fact that most of the

funds collected in the region for the H.S.F. remain in Atlantic Canada. The province of Manitoba with some 4% of the population in contrast received 4.4-5% of MRC funding, 4.8-5.3% NCIC and 6.2-6.7% of H.S.F. funding. However, most scientists would not agree that funding should be distributed strictly on geographic population base alone. However, there may be an argument for retaining provincial donations to research foundations in Atlantic Canada, since it is well known that Atlantic Canadians are by far the most generous givers to charity in the whole of Canada. A further important point which was brought out by Dr. Wood in discussion was that he was able to show a very positive correlation between the MRC funding obtained by the provinces and the amount of research funding provided by the provincial governments (\$/capita). The correlation for all MRC funding was $r=0.750$ $P<0.05$, while for large MRC grants the correlation was much stronger $r=0.912$, $P<0.01$. Dr. Wood met with Dean MacInnis and Assistant Dean (Research) Jones for discussions on Thursday September 22nd. However, perhaps the most important meeting he had during his visit to the region was with the Minister of Health Hon. Ron Stewart on Friday 23rd. We are

sure that Dr. Wood had a very strong message which he would be able to provide for the minister. At previous meetings which have been held with the Minister of Health, Howard Dickson and Derek Jones along with others have strongly argued the case for provincial support for biomedical research. The provision of provincial support would provide seed money which would result in a significant net increase into the province of external research funding. This would occur as researchers in the region became much more efficient and competitive for MRC grants and other external funding. Dr. Wood will be providing the Faculties of Medicine, Dentistry and Health Professions with a copy of his report when it is complete, some time in December.

Medical Revolution

"Since we live in bodies made of molecules, a technology able to rearrange molecules will mean a revolution in medicine."

K. Eric Drexler

Contribution

"We need an environment where Canadians can get up in the morning not just to survive but to contribute, and will get pleasure in giving their talents. We need to wake up to contribution."
Anon

Dr. D.W. Jones
Assistant Dean (Research)

Research Review for 1994

For the past five years a *special edition of the Research News* has been devoted to a review of our ongoing faculty research based upon abstracts submitted to the IADR/AADR/CADR meetings. The following pages 2-6 show nine abstracts which have been submitted for the AADR/CADR meeting to be held in 1995. It should be made clear that this is not by any means a complete review of all of the research being conducted in our faculty. This review does not cover the educational research which is currently being undertaken, which may be presented at the AADS meeting or indeed other research which currently is not documented in the form of an abstract or paper. The object of this mini review of research is to provide to our Faculty and the Dalhousie community an indication of the type and diversity of research which is currently being undertaken. Any faculty members who would like to provide a report of their own specific area of research not covered in this mini review should forward a copy of this on a disk to the Dental Research Development Office. What is particularly impressive about the nine abstracts submitted to the AADR/CADR meeting is the very broad base of our research which has developed rapidly over recent years. The abstracts are listed in alphabetical order of the first named author. The proposed presenter is indicated by*. A total of four projects could be categorized as clinical and five were laboratory based. The listed authors include 12 faculty members, seven students, one ex-faculty member, one colleague from another faculty and one staff member.

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Effects of CO₂ Laser Radiation on Enamel Surrounding Orthodontic Brackets.

T. L. BORAN*, W. LOBB, and J. JOHNSON.

The potential for CO₂ low level laser energy as an enamel preventive treatment to decrease subsurface demineralization in artificially produced carious lesions has been widely reported in the literature. This investigation examined the effect of low-level CO₂ laser radiation on smooth surface enamel surrounding, orthodontic brackets subsequent to the demineralizing process. Ten extracted third molars were painted with acid resistant varnish leaving two windows on the buccal surface next to the orthodontic brackets. Each window measured 1.5 mm in diameter. Window #1 was the control, window #2 (experimental) was treated with CO₂ laser irradiation, 1.5 watts at 0.15 seconds with a 1.5 mm focal spot. The teeth were immersed in the demineralizing solution (2.2mM Ca⁺⁺ and PO₄, 50mM acetic acid, .5p.p.mF @ constant pH=4.3) for 12 days. 100μ hard tissue sections were prepared, imbibed in dH₂O and photographed under polarized light microscope. Photo enlargements were made and the lesion areas were quantified with a planimeter, Student t-test was used to compare lesion area of the control group versus the lased enamel group. Means and standard deviations were as follows: control group=1.47 (.03); experimental group=1.10(.02). The experimental group (lased enamel) showed a significantly smaller zone of demineralization (p=.01). It would appear from this study CO₂ laser has potential to inhibit the subsurface demineralization process around orthodontic brackets. Research is ongoing to determine appropriate para-meters required for increasing reduction of demineralization and increase consistency.

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Effect of Skeletal Deformities on Molar Bites Forces.

R.H. GOODDAY, D.S. PRECIOUS, and P.G. HURLEY*

Bite force studies have frequently been used to evaluate the functional state of the masticatory apparatus. The role of specific sensory systems in controlling and effecting musculoskeletal growth, adaptation or function has not been well defined. The purpose of this study was to compare the effect of skeletal deformities on molar bite force in adolescent and adult dentofacial deformity patients. The study population consisted of 55 adults, between the ages 17 to 37 years, and 37 adolescents, between the ages 11 to 16 years. The adolescent and adult populations were divided into class I, II, III skeletal deformity groups based on Angle's classification and overjet. No individual in the study had previously undergone orthodontic treatment. All subjects were tested using an electronic force transducer to obtain maximum voluntary occlusal force. In the adolescent population, the class I group (n= 8) had a mean bite force 340.7 ± 119.1 N, the class II group (n= 23) 378.5 ± 98.2 N and the class III group (n=6) 243.9 ± 90.3 N. Using a student t-test, the difference between the adolescent class II and class III was significant at the level $p < 0.05$ and agrees with the biomechanical principles applied to the mandible as a class 3 lever. In the adult population, there was no significant difference between the mean bite forces of Class I (n= 9) 354.7 ± 107.8 N, class II (n=31) 342.1 ± 197.7 N and class III (n=15) 354.3 ± 141.8 N deformity groups at level $p < 0.05$.
Conclusions : 1.) In the adolescent population with skeletal deformities, alteration in the bite force was consistent with physical laws of class 3 levers.
2.) In the adult deformity population, application of lever mechanics alone could not explain the resultant bite forces.

Shell Strength, Elastic Moduli and Poisson's Ratio of Composite Materials.

D. W. JONES, A. S. RIZKALLA, E. J. SUTOW, G.C. HALL*& S. BERMINGHAM.

The objective of the present study was to compare elastic moduli and shell strength (Timoshenko disc) for 8 commercial composite materials. Specimens were stored in water @ 37°C for 4 weeks prior to testing. For modulus tests (n = 3) materials were evaluated in air at room temperature using an ultrasonic wave technique (10 MHz resonant frequency). Velocity and density measurements were made on each specimen. Young's, shear, and bulk moduli and Poisson's ratio were calculated. The disc breaking strength values (n =10) evaluated in water @ 37°C ranged from 225.87 ± 25.54 to 99.31 ± 7.72 MPa. The Young's modulus values ranged from 32.30 ± 0.37 to 13.20 ± 0.16 GPa. Poisson's ratio values ranged from 0.307 ± 0.003 to 0.235 ± 0.002 . An exponential correlation was found for filler (wt%) vs. Young's modulus ($r = 0.945$, $P < 0.01$) and for filler (wt%) vs. shell strength ($r = 0.858$, $P < 0.01$). A logarithmic correlation was found for the shell strength vs. Young's modulus ($r = 0.752$, $P < 0.025$). A Student-Newman-Keuls (SNK) rank order test separated shell strength for the 8 materials into 3 different groups and Poisson's ratio into 6 groups ($P = 0.05$). In contrast, an SNK test separated all but two of the 8 materials for the Young's modulus values ($P = 0.05$). The coefficients of variation for modulus tests were significantly lower ($P < 0.001$), 0.84 to 2.4% compared to shell strength, 5.31 to 12.10%. Dynamic modulus tests provide a more sensitive method for comparing mechanical properties of composite systems.

(S. Birmingham was supported by an MRC Farquharson Scholarship.)

Thermal and Mechanical Characterization of Composite Materials.

D. W. JONES*, A. S. RIZKALLA, S. BERMINGHAM, E. J. SUTOW & G. C. HALL.

Objective: To compare thermal expansion (α) and transition temperature (T) for 6 commercial composites. Specimens (discs 6 X 3 mm) were tested (n = 3) in three conditions: i) dry(D) ii) wet(W) and iii) wet-boiled(WB). Prior to testing dry specimens were aged for 4 days in air, hydrated specimens for 2 weeks in distilled water at $37 \pm 1^\circ\text{C}$. The WB specimens were further held for 60 min in water @ 100°C . Thermal analysis (TMA) involved heating from 20 to 100°C at a scanning rate of $10^\circ\text{C}/\text{min}$. The measuring probe applied a force of 100 mN. Modulus values (E) were obtained using an ultrasonic test method. The T values for D ranged from 57.69 to 67.59°C , for W from 60.13 to 69.66°C , and for WB from 52.09 to 60.31°C . Correlations were found for $\alpha D < T$ vs. filler (wt%), $\alpha W < T$ vs. filler (wt%), $\alpha WB < T$ vs. filler (wt%), ($P < 0.01$). Correlations were also found between filler (wt%) and α values of D, W and WB $> T$ ($P < 0.01$). The T values for D, W and WB all correlated with filler (wt%) ($P < 0.05$). Correlations were obtained for TW vs. EW ($P < 0.001$) and for TWB vs. EWB ($P < 0.001$). Correlations were found for $\alpha W < T$ vs. EW ($P < 0.001$), $\alpha W > T$ vs. EW ($P < 0.01$), $\alpha WB < T$ vs. EWB ($P < 0.01$) and $\alpha WB > T$ vs. EWB ($P < 0.01$). No significant difference was found between EW and EWB ($P = 0.05$). Thermal expansion (α above and below T) and T values of all eight composite materials were significantly affected by both storage and boiling in water ($P < 0.01$). Surprisingly, boiling the previously stored wet specimens did not significantly affected elastic modulus values for any of the 8 materials ($P = 0.05$).

Restorative Management of Carious Pits and Fissures: A New Approach

P.A. MILLER*, A.I ISAMIL, W.A. MACINNIS, B. PASS.

Restorative dentistry has always followed the concepts of G. V. Black in the surgical management of carious pits and fissures (PF). The purpose of this study was to test a new approach relying on the extent of the carious lesion in the pit and fissure area to determine the type of restoration (sealant, PRR, amalgam). 9 patients between the ages of 21 and 29 years were screened and lesions were categorized as follows: (1) potentially decayed-pits and fissures are colored light or dark brown at the base, no explorer penetration (2) carious (non-cavitated)-same as (1) but the surface of the lesion is tacky and an explorer tip can penetrate the lesion (3) carious, with cavitation. 8 potentially carious lesions, 11 carious non-cavitated, and 8 cavitated lesions were opened using the "biopsy cavity" technique. The extent of the lesion was recorded as stain in enamel, decay in enamel, decay in shallow dentin, or decay in deep dentin. Out of the 8 potentially carious PF, 5 (62.5%) were non-carious but stained, and 3 (37.5%), had enamel caries. Out of the 11 carious non-cavitated PF, 7 (63.6%), had enamel caries, 1 had shallow dentinal caries, and 3 (27.3%) had deep dentinal caries. Only 2 (25.0%) out of the 8 cavitated PF had caries in enamel. 75% of the cavitated pits and fissures had either shallow or deep dentinal caries. The likelihood ratio (LR) of potentially carious lesion being found during biopsy to have dentinal caries is 0, the LR that a non-cavitated carious pit and fissure is found to have dentinal caries is 0.97, and the LR that a cavitated carious pits and fissures is found with dentinal caries is 5.1. The extent of the carious lesion should be the determinant of the type of restoration placed. Dentistry should perhaps re-examine the need to treat most pit and fissure carious lesions with a traditional Class I restoration.

Characterization of Experimental Bioceramic Compositions.

A. S. RIZKALLA*, D. W. JONES, D. B. CLARKE, G. C. HALL & S. BERMINGHAM.

Objective: To characterize 6 different experimental compositions of potentially bioactive glass-ceramic materials. Materials evaluated had the following CaO/P₂O₅ ratios ranging from 3.23-9.06, SiO₂/CaO ratio from 1.02-4.63 and Na₂O ranging from 5-10%. Chemical analysis, activation energy (Q) and modulus of elasticity of sintered glass materials were compared. The mechanical properties of the experimental materials were characterized by means of an ultrasonic technique to determine Young's (E), shear, bulk moduli and Poisson's ratio. Cylindrical specimens (6 x 4 mm) were prepared from each formulation (n=3). The temperature of crystallization and Q of each glass formulation were determined from DTA exotherms. X-ray diffraction of the materials was also conducted. A modified form of the Johnson-Mehl-Avrami transformation equation, was used to calculate the kinetic parameters for crystallization of the glass formulations. A Student-Newman-Keuls rank order test separated all six glass-ceramic formulations in terms of E (P= 0.05). Correlations were found between E and CaO/P₂O₅ (P< 0.01), between CaO/P₂O₅ and Poisson's ratio (P<0.001), between CaO/P₂O₅ and density (P< 0.001) and between CaO/P₂O₅ and Q (P<0.001). Correlations were also found between Q and E (P<0.001) between Q and density (P<0.001) and between Q and Poisson's ratio (P<0.001). Conclusion: The ultrasonic method proved to be a sensitive and effective technique for illustrating the influence on mechanical properties of both chemical composition, and crystallization phase development.

An Investigation of the Relationships Among Denture Cleanliness, Salivary Flow, Drug History, and Gum Chewing.

K. Sawler*, D. Chaytor, W. C. Foong, A. Ismail, R. Brygider.

To determine the relationships among denture cleanliness, salivary flow, drug history, and gum chewing, 28 randomly selected complete denture patients were recalled. Prostheses were evaluated using existing clinic criteria, health and drug histories recorded, unstimulated salivary flow measured and denture plaque stained (Vivadent Plaque Test Indicator Liquid) and videographed. Staining and videographing were repeated at two 2 week intervals. Anterior mandibular lingual and left maxillary buccal plaque areas were later digitally measured using NIH Image . All patients were instructed on denture hygiene, half were issued chewing gum to use 20 minutes 3+ times daily. Dentures met clinical criteria. 9 patients were taking xerostomic drugs.

Mean salivary flow (visit 3) was 4.6 ml SD 4.1

Mean (SD) plaque areas mm²:

visit	1	2	3
Maxilla	49.59 (62.51)	13.49 (30.41)	10.39 (20.77)
Mandible	29.19 (39.22)	7.46 (13.50)	7.03 (20.70)

ANOVA revealed a significant (.05) difference in maxillary plaque accumulation between visit 1 and visits 2 and 3 but no significant difference in plaque accumulation amongst sub groups: visit 1 / visit 2: drugs/non-drugs; gum chewing/non gum chewing. Denture hygiene was improved as a result of the recall activity, however the subgroup populations appear to have been too small to reveal statistically significant interactions. This project was supported by a Dentistry Canada Fund Wrigley Student Research Award and Ivoclar NA Inc.

Patient Utility in Outcomes Assessment of Orthodontic Patients.

D.V. SMITH*, W.K. LOBB, A.I. ISMAIL.

Outcomes assessment of orthodontic patients should not be only based on clinical measures, but should also assess patient utilities. The purpose of this investigation was to assess the perceptions of the patient and patient satisfaction with treatment outcomes, and, furthermore, to assess the treatment outcomes based on the change in the Dental Aesthetic Index (DAI). A patient satisfaction questionnaire was completed by telephone for patients that had completed orthodontic treatment at the Faculty of Dentistry of Dalhousie University between September 1989 and June 1994. 142 of 210 patients responded to the telephone questionnaire, with 89.4% expressing satisfaction with their teeth after orthodontic treatment. 94.4% and 89.4% of the patients felt that orthodontic treatment improved the appearance of their teeth and smile, respectively. There is a significant correlation between the patient's level of satisfaction and the perceived improvement in the appearance of their teeth and their smile after orthodontic treatment (X^2 , $p < 0.01$). 75 of the 142 patients had complete pre- and post-treatment casts. From this subgroup, DAI scores were computed and ranged from 16 to 66 (median value=32) for pre-treatment and 17 to 54 (median value=24) for post-treatment. The change in DAI scores ranged from -6 to 38 (mean 7.2) which was a significant decrease (Student t-test, $p < 0.01$). However, 16 of 75 (21.3%) had an increase or no change in DAI score. Of these, 14 were satisfied with treatment results. Of the 59 patients with improved DAI scores after treatment, 8 were unsatisfied with treatment outcomes but had a mean decrease in DAI score of 7.9. The change in DAI scores was not significantly different between patients who were satisfied or unsatisfied (X^2 , $p < 0.05$). The results of this study suggest that patient satisfaction is high with orthodontic treatment outcomes, but the DAI does not correlate well with patient perception of treatment success.

Measuring Percent Porcelain Retention by the Pulse Potentiostatic Method.

E.J. SUTOW,* D.B. CLARKE, D.W. JONES, A.S. RIZKALLA and V.W. KE.

A previous study (AADR, Abst. #822, 1992) indicated the pulse potentiostatic method (PPM) could measure accurately porcelain coverage of standard specimens. The objective of the current study was to use the PPM to determine percent porcelain retention following mechanical debonding and to compare the results with surface area analysis using backscattered electron images (BEI). Disc specimens were made using two high noble metal content alloys: Rx SFC (Rx) and Lodestar (L). Opaque porcelain was fired onto the test specimens and then mechanically debonded (Rx: $n=10$ and L: $n=11$). Calibration specimens for the PPM received simulated porcelain firings. Calibration and test specimens were placed in a 0.1% sodium borate solution at 24°C for testing. Using a potentiostat, specimens were cathodically polarized at 1000 mV below their 1 hour open circuit potential. Following 1.5 h cathodic polarization, specimens were returned to open circuit for 1.5 h. This cycle was repeated for a total of three times. At zero polarization, specimens were then subjected to 60 mV pulses, by a pulse generator. The resulting current-time curves were stored on a digital oscilloscope. Total charge was found by integrating the curves. Specimens were also examined by light microscopy. Using linear regression analysis, calibration curves of total charge vs. known areas gave Rx: $r=0.975$ ($p < 0.001$) and L: $r=0.989$ ($p < 0.001$). Results showed that the mean absolute differences between the PPM and the BEI method for detected percent porcelain retention on the debonded test specimens were Rx: $3.1 \pm 3.4\%$ (range: 0.1-9.1%) and L: $5.5 \pm 4.8\%$ (range: 0.0-15.6%). Many areas of thin porcelain coverage detected by the PPM and BEI method were undetected by light microscopy. It was concluded that the PPM is a sufficiently accurate technique for determining percent porcelain retention.

(V.W. Ke was supported by a MRC Farquharson Scholarship.)

Research Grant for Ismail

The Dental Research News congratulates Dr. Amid Ismail who has received an NHRDP grant for \$32,000 and a further \$3,000 from the Nova Scotia Department of Health to support his epidemiology research. There has never been a province-wide survey of the oral health status of children and adolescents in Nova Scotia. Dental health planning has relied mostly on the opinions and assumptions of experts. The proposed survey is the first attempt to base the planning and re-structuring of dental health care on scientific evaluation of the oral health status of children and adolescents and the development of new objectives based upon the current distribution of disease rather than past ones. This survey is organized to identify those areas or groups in Nova Scotia that have the highest prevalence of dental caries, fluorosis, periodontal diseases, and malocclusion. Risk markers which could identify children in need of prevention and treatment will be investigated. The survey will be carried out in two phases. During Phase I a pilot/feasibility study will be carried out involving 600 students selected from one urban and one rural school board in Nova Scotia. From each school board, a systematic sample of classrooms will be selected from grades 1, 6 and 9. A telephone questionnaire will be administered by the project staff who will be trained by Statistics Canada. A trained and calibrated dentist will examine for dental caries, dental fluorosis, periodontal disease, and malocclusion, using criteria which have been shown to be valid and reliable. Data from the Phase I survey will be used to estimate response rate, sample

size, budget, reliability of questionnaire, and examination criteria, and relevance of findings. Phase II of the survey will include all school boards in Nova Scotia and will provide data applicable to the new Regional Health Boards to plan oral health care in the province.

Abstract Trivia

The nine abstract reproduced in this addition of the Dental Research News in their original form as submitted made use of the following five different font types:

Bookman -12,
New Century Schoolbook-12,
New York -10,
Avant Garde -10 Bold,
and Courier -10.

The most common was Bookman -12 in which four of the abstracts were produced. A previous analysis (Dental Research News Vol.VII, No 2, Feb. 1993 page 2) of the type and size of font used for abstracts submitted for the IADR meeting in Chicago in 1993 revealed that six different fonts and two sizes were used at that time. Although each abstract submitted this year had the same space in which to present the information the number of words used varied greatly. The number of words had a mean of 306.56 ± 34.74 . The median was 319.00, the range was 84 from 343 to 259. The average number of authors on the nine abstracts for this years meeting was 3.3.

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Ultimate Goal

"If you don't know what your goal is— what it looks like, feels like, tastes like— then how do you know you are there." *Anon.*

Students Selected for Abstract Submission.

Two students were selected by drawing names, to have an abstract based upon research projects on which they had been working during the summer, submitted for consideration to the AADR/CADR meeting for next March. The two lucky students were 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. If the abstracts are accepted by the programme committee the two students will be travelling to San Antonio to present the papers at a meeting which will have an attendance of about 5,000 dental scientists.

"RESEARCH NEWS ITEMS"

Do you have any research news which you would like to share with your colleagues? If so, please forward such items to the Research Development Office. It would help if submissions were produced on a (Macintosh) disc in Microsoft Word:

-or simply call ☎ 1675.

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Building on Our Research Base

"Sure I am that this day now we are masters of our fate, that the task which has been set us is not above our strength, that its pangs and toils are not beyond our endurance."

Winston S. Churchill.

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The Best Investment

"The dividends from support of science are spectacular and remain one of our best investments."

John I. Brauman