



Stimulus & Challenge

The voice of Dal Dental research

Dental

NOVEMBER 1994

Research News

Research Development Office, (902) 494-1675

VOLUME VIII, NUMBER 11.

Congratulations Brian

The Division of Biomaterials is pleased to announce that on October 21st 1994 Brian Smyth successfully defended his thesis:

"An Experimental Strain Analysis of the Human Pelvis With Varying Size Total Hip Acetabular Implants."

The research project was jointly supervised by the Division of Biomaterials and the Division of Orthopedics, Department of Surgery.

The research project involved mechanical tests being conducted on six preserved human cadaveric hip joints. These were instrumented with ten strain gauges of the rosette type on both the superior and inferior rim of the acetabulum and medial wall.

A theoretical analysis of acetabular loading was conducted to determine the orientation of the load vector as a function of (walking) the gait cycle. A partial weight bearing loading regime for the experimental analysis was then derived to encompass this loading pattern.

Loads were applied initially to the intact hip to determine natural strain patterns. Following this, an extensive parametric study was performed using both solid mild steel and ultra-high molecular weight polyethylene acetabular cups.

These are the socket component of the ball and socket hip joint prosthesis. These cups were produced to simulate 1mm under size, exact fit and 1mm and 2 mm

oversized implants. The data indicated that increasing the loading angle from 50 to 70 degrees produced an increase in tensile stresses in the superior acetabular rim, a decrease in medial wall tensile strains, and an increase in compressive strains in the medial wall. It was concluded that, although an acetabular prostheses of 1 mm under size produced periacetabular strains similar to those observed when loading with the natural proximal femur, an implant of this relative size may lack the initial stability required for ingrowth to occur. It was concluded that care should be taken when implanting oversized components, as they were associated with significant increases in strain in both the acetabular rim and the medial wall in laboratory simulations.

Abstract Submitted

The following abstract has been submitted to the American Ceramic Society Symposium on Bioceramics being held next spring.

FRACTURE TOUGHNESS OF BIOGLASS/CERAMIC SYSTEMS

D. W. Jones and A. S. Rizkalla, The main objective of this study was to evaluate the mechanical properties of a range of glass/ceramic compositions synthesized by wet chemical methods. These glasses had CaO/P₂O₅ ratios ranging from

3.23-9.06, SiO₂/CaO ratios from 1.02-4.64 and Na₂O Wt% from 5-10%. The nonbridging oxygen content ranged from 24.5-60.5%. Glass-ceramics were obtained after heat treating the glasses at temperatures determined from their DTA exotherms. Dynamic Young's, shear and bulk moduli and Poisson's ratio of the glasses and glass-ceramics (n = 3) were determined by means of an ultrasonic method. True hardness was measured by means of a Knoop indenter and a technique developed by Li *et al.*. Fracture toughness (n = 30) was evaluated by means of a Vickers indenter using Blendell's equation. Significant correlations were obtained between the Young's, shear, bulk moduli, Poisson's ratio, true hardness, fracture toughness and nonbridging oxygen content within these materials p < 0.01. Significant difference in the mechanical properties were also observed between the as cast and cerammed materials p = 0.05.

Our Responsibility

"Every individual in society accepts responsibility for seeking, transferring and sharing knowledge. Each one is a learner and a teacher, all at the same time." Anon.

Mercury —Amalgam Publications.

At a time when it is rumored that the British television programme dealing with the mercury issue in dentistry (Poison in your mouth) is to be aired in Canada soon, it is interesting to note that a number of our faculty members have recently published papers dealing with mercury from amalgam. A paper has been published by Helen Lyttle and George Bowden. "The level of mercury in human dental plaque and interaction *in vitro* between biofilms of *Streptococcus mutans* and dental amalgam." (J. Dent. Res. 72: 1320-1324, 1993). Mercury levels in dental plaque from amalgam and enamel surfaces in human subjects with amalgam restorations were determined. The levels of mercury in plaque from amalgam surfaces were found to be significantly higher than those from plaque on enamel. No mercury was detected in plaque from subjects without amalgam restorations. The mean level of mercury in a 24-hour collection of plaque was 2 micrograms, an amount close to those calculated by other workers for the amount of mercury liberated in the mouth from amalgam restorations in 24 hours. *In vitro*, biofilms of *Streptococcus mutans* facilitated the release of mercury from freshly prepared amalgam, in what appeared to be a cyclical fashion. An interesting finding was that amalgam aged for two years did not release mercury, even when supporting the growth of an *S. mutans* biofilm. The resistance of aged amalgam was attributed to the presence of a passive tarnish layer. The mercury released by the biofilm had an effect on the composition of the biofilm. The biofilms on fresh amalgam had significantly lower levels of carbohydrate than

did biofilms on aged amalgam and on control stainless steel wires. An abstract of this paper was reproduced in the September issue of the Canadian Dental Journal. vol. 60 :769, 1994. A second paper by the same authors was entitled "The resistance and adaptation of selected oral bacteria to mercury and its impact on their growth" (J. Dent. Res. 72: 1325-1330, 1993). This research aimed to determine if selected strains of oral *Streptococcus* and *Actinomyces* would be able to grow in the presence of mercury. Sensitivities to mercury were initially measured on agar plates, and subsequently, selected strains were grown in broth so that the impact of mercury on the growth characteristics could also be determined. It was found that *Streptococci* were more resistant to mercury than *Actinomyces*. Enrichment cultures of samples of human dental plaque showed that streptococci were the most resistant organisms that could be cultured on the medium and that these strains could adapt to relatively high mercury concentrations.

A further paper by Elliott Sutow *et. al.* has also been published "Mercury Vapour Suppression by Various Liquid Media." (J. Oral. Rehab. 21: 553-58, 1994) This paper evaluated fresh and used photographic fixer, a commercial mercury vapour suppressant and regular water. Mercury vapour concentrations above the four test storage liquids was measured at various times up to 335 days. The results showed that water was very much less effective compared to the other 3 liquids in suppressing the mercury vapour. Another paper which has just been re-produced in the British Dental Journal is by Derek Jones "The Enigma of Amalgam in Dentistry."

This review paper was re-published in the September 10th 1994 issue of the British Dental Journal. The paper having been previously published in J. Canad. Dent. Assoc. 59: 155-166, 1993. The rationale for re-publishing the paper in the British Dental Journal was related to the controversy surrounding the BBC television program Panorama —Poison in Your Mouth which was broadcast in Britain in July 1994.

Centres of Excellence

The Dental Research News is very pleased to report that confirmation has been received that the preliminary *Letter of Intent* for the Centres of Excellence programme in Biomaterials submitted in collaboration with colleagues in Toronto has been successful. The task of producing the full proposal for the deadline of January 13th 1995 is now underway. The Dalhousie group are part of a very powerful national group which now has participation from the Maritimes to BC. The three projects which have been put forward as part of Dalhousie's participation in the Centres of Excellence proposal were highlighted in the September issue of the Dental Research News (vol VII, No. 9 page 3). The Biomaterials group application is now one of only three groups which are being considered for funding as part of the C of E programme and thus stand a one in three chance of being successful. Sixty four other groups have been eliminated in the first phase of the selection process.

Substantive Knowledge

"One cannot depend solely on the formal characteristics of the research design to draw inferences. One must have substantive knowledge.

Ernest R. House, Educ. Res., Aug-Sept. 1991 p 2-9.

Neurotoxicology Conference

An international conference was held in Arkansas, October 30th Nov. 2nd 1994. The theme of the meeting was "Neurotoxicity of Mercury: Indicators and Effects of Low-Level Exposure." A total of over 160 attendees were present at this international meeting, delegates were present from eight countries. A total of 36 papers and 44 posters were presented dealing with, cell biology, neurophysiology, toxicology, and biostatistical risk assessment of mercury. Interestingly, although Dr. Fritz Lorscheider had two abstracts reproduced in the program, only one of them was provided with space in the meeting to be presented. The first of these papers listed was "Toxicity of Ionic Mercury and Elemental Mercury Vapour on Brain Neuronal Protein Metabolism." The second was titled "Amalgam Mercury —Emerging Evidence Questions A Dental Paradigm." This second paper appears to be a review of the publications of Lorscheider and Vimy *et. al.* over the past several years. This paper was not presented at the meeting, however, Dr. Lorscheider did preambule the presentation of his first abstract paper with a listing of publications by his group which were said to indicate a major concern and questioned the continued use of amalgam as a dental material.

Dr. Lorscheider presented his scheduled paper dealing with toxicity of ionic mercury and elemental mercury vapour on brain neuronal protein metabolism in rats. He made the statement that mercury is selectively concentrated in human brain regions involved in memory functions, and may be implicated in the etiology of Alzheimer's disease. It should be noted that

Dr. Haley of the University of Kentucky stated on the BBC Panorama Programme that he was not able to claim any connection between Alzheimer's disease and mercury from dental amalgam. Dr. Lorscheider described a study in which rats were exposed to mercury vapour concentrations of $300 \mu\text{g Hg/m}^3$ this was said to be a level selected representing that which could be detected in human mouths. This is in spite of the fact that this level measured by Vimy *et. al.* has been shown by others to be totally erroneous. The results indicated that mercury vapour inhibits polymerization of tubulin essential for formation of microtubules. A question was asked, why was it that no one had ever shown evidence of observed neuropathology at these levels of mercury exposure. Dr. Lorscheider said he didn't know. The conclusion of the paper stated that low-levels of mercury vapour exposures inhibit the polymerization of tubulin. However, a value of $300 \mu\text{g Hg/m}^3$ can not be described as a low level of mercury vapour exposure representative of dental amalgam in the human mouth. This value is six times the WHO TLV level. The $300 \mu\text{g Hg/m}^3$ value is also two orders of magnitude above the accepted values for mercury vapour given off from dental amalgam. It is unfortunate that this level of exposure was chosen since even though the experiment deals with rats, it is not possible to draw any tentative conclusions which have any meaningful application to the dental situation.

A poster was presented by Dr. Michael Ziff a well known crusader against the continued use of amalgam as a dental restorative material. This poster dealt with an estimate of the contribution made by dental mercury as a contaminant of the environment. The poster was based upon

estimates of dental amalgam usage. An important point which was not mentioned in this presentation was the fact that modern dental amalgam is dispensed in capsules which significantly reduce the possibility of mercury wastage. It should also be noted that dentists being reasonably frugal by nature do not throw away the scrap amalgam which remains unused when they complete an operative procedure. The silver-rich scrap amalgam is saved and forwarded in return for cash by the dentist to metallurgical assay companies who recycle the silver. The contribution of dentistry to the environmental contamination is insignificant compared to that which is contributed from industrial and natural sources. Dr. Thornton reported at the conference that 50% of all mercury in the environment comes from natural sources. Dr. Ziff failed to acknowledge in his poster presentation the obvious fact that the use of amalgam has significantly declined in recent years due to the decline in the incidence of dental caries. Dr. Ziff also fails to acknowledge that the MRC in Sweden have suggested that the contamination of the environment from dental offices can be adequately dealt with by use of mercury traps on dental units. Dr. Ziff also made available a video of the controversial BBC Panorama Programme which was played continually for the benefit of the delegates during the poster sessions and coffee break. The papers presented at the conference did not provide any negative implications for the continued use of dental amalgam. From the dental standpoint the important factor to note is that methyl mercury can cross the blood brain barrier, while inorganic mercury fails to do this.

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