MORE NEW RESEARCH - AMALGAM MERCURY HARM DENTAL PERSONNEL!

In the last issue of the Bio-Probe Newsletter [Vol. 11(1), Jan 1995], a new study demonstrating neurobehavioral damage in dental personnel caused by exposure to amalgam mercury was reported [Gonzalez-Ramirez, D. et al. Sodium 2,3-dimercaptopropane-1-sulfonate challenge test for mercury in humans: II. Urinary mercury, porphyrins and neurobehavioral changes in dental workers in Monterrey, Mexico. J Pharmacol Exp Therap. 272:264-274, 1995]. The abstract that follows reflects another study, that has just been published, showing these adverse neurobehavioral effects in United States dentists [this study was supported by the American Dental Association and the National Institute of Dental Research].

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Echeverria, D; Heyer, NJ; Martin, MD; Naleway, CA; Woods, JS; Bittner, AC, Jr.
Behavioral Effects of Low-Level Exposure to Hg\textsuperscript{0} Among Dentists.

ABSTRACT:
Exposure thresholds for health effects associated with elemental mercury (Hg\textsuperscript{0}) exposure were examined by comparing behavioral test scores of 19 exposed (mean urinary Hg =36 ug/l) with those of 20 unexposed dentists. Thirty-six ug Hg/l is 7 times greater than the 5 ug Hg/l mean level measured in a national sample of dentists. To improve the distinction between recent and cumulative effects, the study also evaluated porphyrin concentrations in urine, which are correlated with renal Hg content (a measure of cumulative body burden).

Subjects provided an on-site urine sample, were administered a 1-hr assessment consisting of a consent form, the Profile of Mood Scales, a symptom and medical questionnaire, and 6 behavioral tests: digit-span, symbol-digit substitution, simple reaction time, the ability to switch between tasks, vocabulary, and the One Hole Test. Multivariate regression techniques were used to evaluate dose-effects controlling for the effects of age, race, gender and alcohol consumption. A dose-effect was considered statistically significant below a p value of 0.05.

Significant urinary Hg dose-effects were found for poor mental concentration, emotional lability, somatosensory irritation, and mood scores. Individual tests evaluating cognitive and motor function changed in the expected directions but were not significantly associated with urinary Hg. However, the pooled sum of rank scores for combinations of tests within domains were significantly associated with urinary Hg, providing evidence of subtle preclinical changes in behavior associated with Hg exposure.
Coproporphyrin, one of three urinary porphyrins altered by mercury exposure, was significantly associated with deficits in digit span and simple reaction time. The porphyrin pooled sums of rank scores were as sensitive as the urinary Hg analyses within the cognitive and motor domains but were less sensitive for the overall battery of tests.

The reported effects were detected among dentists with a mean urinary Hg level of 36 μg/l, which lies between the proposed biologic thresholds of 25 and 50 μg Hg/creatinine, suggesting the need for a more comprehensive study to determine the threshold of adverse biologic effects.

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MERCURY A HEALTH HAZARD TO DENTAL PERSONNEL - YES OR NO?

These two recently published studies (D. Gonzalez-Ramirez, et al., 1995 and D. Echeverria, et al., 1995) present a singular dilemma to the dental profession, which has steadfastly claimed that patients could not possibly be harmed by amalgam mercury since dental personnel suffer no adverse mercury effects.


In 1992, Ngim and associates evaluated 98 dentists and 54 controls who were not dentists [Ngim, CH; et al. Chronic neurobehavioral effects of elemental mercury in dentists. Br J Ind Med. 49(11):782-790, 1992]. Dentists exposed to air concentrations of 16.6 μg Hg/m³ were found to have poorer performance in mood, motor speed (finger tapping), visual scanning (trail making), visuomotor coordination and concentration (symbol-digit), digit span, logical memory, and visual reproduction. The dentists also had a higher aggression score than the controls.

It is interesting to note that the Echeverria team found a significant effect in dentists for behavioral parameters, including poor mental concentration, emotional lability, somatosensory irritation, and total mood scores. It is also notable that the Echeverria group stated that "urinary Hg levels provide a more reliable estimate of recent exposure/dose" than do air mercury concentrations (used in the Ngim, et al. study).

As far back as the 1960's, mercury toxicology experts had determined that levels of mercury in urine (and blood) were not valid indicators of body burden or toxic effects of mercury. This has been repeatedly confirmed through the years [NICS-HV-1973, USEPA-1984, WHO-1991]. It has even been formally acknowledged by the American Dental Association and the National Institute of Dental Research [NIDR/ADA. Workshop: Biocompatibility of metals in dentistry. JADA, 109:469-471, 1984].

The Gonzalez-Ramirez, et al. study investigated the correlation of neurobehavioral effects to urine mercury levels before and after administration of DMPS, a mercury chelating agent. They found that the adverse neurobehavioral effects of complex attention, a psychomotor task, mood and symptoms correlated to urine mercury levels after administration of DMPS, but not before. The findings in the Echeverria study might have been even more dramatic had the DMPS-challenge technique been utilized.

Consideration of the previous knowledge of the urine mercury levels might have been interesting in yet another context. It is quite possible that the control group of dentists may have had considerably higher body burdens of mercury than the levels revealed by simple urine measurement, without the benefit of DMPS-challenge. If so, then the utilization of a control group in the Echeverria study that did not include dentists, as was performed in the Ngim study, may have revealed even more dramatic effects in dentists.

One thing is certain, the Gonzalez-Ramirez and the Echeverria studies present data that demonstrate adverse neurobehavioral effects on dental personnel, a development in the amalgam controversy that is certainly uncomfortable for the dental profession.

There are other published studies that have demonstrated non-neurological adverse effects to mercury in dental personnel. These studies primarily addressed adverse reproductive effects and have been well publicized in a number of review documents.

Why then, does the dental profession continue to declare that dental personnel suffer no adverse effects from dental mercury and what defense is offered to counter the extensive documentation to the contrary? The position of organized dentistry has been based on two factors; the American Dental Association's (ADA) Morbidity/Mortality reports, published in the ADA Journal (JADA), and the 1985 study by Brodsky and associates, also published in JADA [Brodsky JG, et al. Occupational exposure to

Review of the ADA Morbidity/Mortality reports quickly reveals that all dentists were compared to the general population. Neither group was divided into those who did and did not have dental amalgams. Since dentists are, or should be, more attuned to prevention of dental problems and also have a greater capability to have gold restorations, it is probable that the average number of amalgam fillings possessed by dentists is significantly less than that of the general population. Moreover, dentists who use amalgam in their practice were not separated from those who do not, such as certain groups of specialists. It is obvious that these Morbidity/Mortality reports have no relationship whatsoever to the issue of the safety of dental amalgam, either in the mouths of subjects or the practice of dentistry.

The 1985 Brodsky study is also very interesting. The expressed goal of the study was to "examine the relationship of mercury exposure and pregnancy outcome among dental professionals and their spouses." A questionnaire survey was mailed to 29,514 male dentists and 30,272 female dental assistants. Respondents were asked to report occurrences of spontaneous abortions or congenital abnormalities. More than 70% (21,634) of the dentists and dental assistants (21,202) completed and returned the questionnaire.

The subjects were originally divided into three mercury exposure groups, one of which was a "no exposure" group. This was subsequently revised into two groups; one of dental personnel and their wives where 40 or less amalgams/week were placed (low direct and indirect exposure groups), and one of dental personnel and their wives where more than 40 amalgams/week were placed (high direct and indirect exposure groups). As no data was provided, the low and high exposure groups may well have averaged 39 and 40 amalgams placed per week, hardly a scientifically valid comparison.

In view of the weakness of the position of the dental profession in the face of mounting contrary documentation and the absolute reliance of the practicing dentist on its leadership, one must wonder what response will occur when the dental practitioners learn that they have possibly been place at personal risk as a result of the use of dental amalgam.

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ATSDR "MINIMAL RISK LEVEL" FOR MERCURY VAPOR INHALATION!

The Agency for Toxic Substances and Disease Registry (ATSDR) of the U.S. Public Health Service recently published its "Toxicological Profile for Mercury (Update)" [ATSDR. TP-93/10]. Public Law 99-499 extended and amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund") by directing the ATSDR to prepare toxicological profiles for hazardous substances most commonly found on the CERCLA National Priorities List that pose the most significant potential threat to human health, as determined by ATSDR and EPA. The list of the 275 most hazardous substances (ED: which includes mercury) was published in the Federal Register [57 FR 48801, 28 Oct 1992].

"The ATSDR toxicological profile is intended to succinctly characterize the toxicological and adverse health effects information for the hazardous substance being described. Each profile identifies and reviews the key literature (that has been peer-reviewed) that describes a hazardous substance's toxicological properties. Other pertinent literature is also presented, but described in less detail than the key studies."

"This profile reflects our assessment of all relevant toxicological testing and information that has been peer reviewed. It has been reviewed by scientists from ATSDR, the Centers for Disease Control and Prevention (CDC), and other federal agencies. It has also been reviewed by a panel of nongovernmental peer reviewers and was made available for public review."

"The principal audiences for the toxicological profiles are health professionals at the federal, state, and local levels, interested private sector organizations and groups, and members of the public." [Forward: Pages v-vi.]

The ATSDR has established "Minimal Risk Levels (MRL's)" for the various forms of mercury related to their route of exposure. The MRL's for inhalation of mercury vapor are contained in Section 2.4, entitled "Relevance to Public Health," pages 125-128 ("Inhalation MRL's"). The ATSDR MRL for acute inhalation exposure to metallic mercury vapor is $2 \times 10^{-5}$ mg Hg/m$^3$ (0.02 mcg Hg/m$^3$) and the MRL for chronic inhalation exposure to metallic mercury vapor is $1.4 \times 10^{-3}$ mg Hg/m$^3$ (0.014 mcg Hg/m$^3$). These standards are both well below (by more than 200 times) exposure levels to mercury vapor that have been well documented to ematate from amalgam dental fillings, even in the absence of stimulation.

Studies of office exposure to dental personnel and exposure to in vivo dental amalgam fillings are referenced in the ATSDR document. Humans with dental amalgam fillings are identified as having potentially high exposures to mercury (page 233) and the unborn (prenatal) and newborn are identified as being unusually susceptible to the effects of mercury exposure (page 179). As a recent human autopsy study and three previous
animal studies have established the transfer of amalgam mercury from the fillings of pregnant females into the tissues of unborn babies, special consideration should be directed to this concern.

In the preceding issue of the Bio-Probe Newsletter [Vol 11(1):3, Jan 1995] various United States government standards for mercury exposure for the general population were presented. For inhalation of mercury vapor, the USEPA "Reference Dose" is 0.3 mcg Hg/m³, considerably higher than the ATSDR MRL of 0.014 mcg Hg/m³ for chronic inhalation of mercury vapor. In view of the statements presented in the forward of the ATSDR document, there is NO EXCUSE for health professionals (dental or otherwise) or government officials to continue relating mercury vapor exposure from amalgam dental fillings to the OSHA TLV-TWA of 50 mcg Hg/m³, which is specifically limited to medically monitored otherwise healthy workers with no more than 40 hours per week of exposure!

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DENTAL AMALGAM MERCURY IN THE ENVIRONMENT - UPDATE!

After announcing plans to require dental offices to have amalgam separators in waste water outlets in order to protect the environment from dental amalgam mercury, the Seattle/King County (Washington) METRO (Department of Metropolitan Services) has recently announced an abrupt and unexplained reversal of policy. Previously, METRO had determined that 14% of the mercury found in environmental water was derived from dental offices, which was the basis for their ruling to eliminate a major source of environmental mercury pollution.

In the announcement of the sudden policy reversal David Grigsby, director of METRO's Water Pollution Control Department stated: "Many dental offices have already installed amalgam separation units and we expect this practice to continue without a formal regulatory requirement. We believe this decision is in our community's best interest because it is cost-effective and protects our environment." METRO outlined five steps it will take:

- Promote voluntary use of amalgam separation units (to reduce discharge of amalgam in waste water).
- Continue its approval process of these units.
- Continue education efforts for dentists.
- Support research to determine the environmental fate of amalgam in municipal waste water treatment plants and biosolids.
- Continue reviewing mercury values in treatment plant influent, effluent and biosolids to confirm that mercury levels remain low.

The American Dental Association reported on this METRO reversal in the ADA News [Vol. 26(4):1, 20 Feb 1995] article entitled "Grassroots Victory in Seattle." Reporting the tremendous effort expended by organized dentistry on the national, state and local levels, the ADA clearly identified the "grass roots" as that of organized dentistry, not of the public. Dr. Victor Barry, ADA 11th district trustee and past president of the Washington State Dental Association, was quoted as saying: "It's a good thing if we can use low tech and low cost methods for removing as much amalgam as possible from waste water. We want to be good citizens and environmentally responsible."

In view of the admission that the fate of dental amalgam mercury is unknown, the wisdom of reliance on voluntary compliance of the dental profession remains to be seen; after all, this has been the case up to now! Metro Seattle is not the only area investigating dentistry's contribution to environmental mercury pollution. This is obviously a currently hot topic. Four European nations already require amalgam separators in dental office waste water streams. A number of other locales in the United States are addressing this concern, including the San Francisco Bay area, San Bernardino, Tucson, Detroit, Minnesota, and Washington, D.C. Estimates of dentistry's contribution to environmental mercury have ranged from 14% to 50%.

The definition of "voluntary compliance" must also be addressed. Assuming that all, or at least most, dentists have amalgam separators installed in their office waste water lines (numerous mercury-free dentists around the country have already done so), will dentists be conscientious enough to dispose of the amalgam waste properly? Most amalgam separators are not expensive; disposal of the waste is the costly factor! Further, few of the companies providing amalgam separators have arrangements to dispose of the waste; most leave that responsibility in the hands of the dentists. In view of this expense, it is not inconceivable that some dentists would simply dump the waste in the trash or in a toilet at another locale.

The dental establishment, led by the American Dental Association, answers these environmental concerns by claiming that "amalgam" is not "mercury," the amalgam being so stable that its mercury content is not released to the environment.
For many years, dentists have been instructed to store scrap amalgam under a sulfur solution in tightly sealed containers and to dispose of the material in an environmentally sound manner. Further, the position of the dental establishment regarding amalgam in patients was that mercury was "locked in" dental amalgam and therefore rendered "harmless", in spite of documentation to the contrary dating back to the 19th century. Finally, the dental profession had to admit that mercury was indeed continuously released from mixed dental amalgam. Now, however, the profession says that mercury is released only when mixed amalgam is in the dental office or in the mouths of patients. Mercury is not released when amalgam is in the environment.

The recently published study by Sutow and associates, abstracted below, confirms that submerging dental amalgam in water does NOT prevent the escape of mercury. Now, all of a sudden, we are told that scrap amalgam in the environment is NOT a hazard! It would seem that a conflicting message on scrap amalgam is now being developed by the dental profession, a policy that cannot possibly bode well for public confidence in the profession.

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ABSTRACTS

Sutow, EJ; Foong, WC; Rizkalla, AS; Jones, DW; Power, NL.
Mercury Vapour Suppression by Various Liquid Media.

ABSTRACT:
Fresh and used photographic fixer, Mercovap and water were evaluated for their ability to suppress the vapourization of mercury. Mercury vapour concentration above the four test storage liquids was measured at various times between 10 min and 335 days, using a mercury vapour measuring instrument. The data were analyzed using a Student-Newman-Keuls multiple comparison test (P =0.05).

The results showed that fresh and used fixer and Mercovap suppressed the vapourization of mercury to below the detection limit of the measuring instrument (0.01 mg/m3). Water was much less effective compared with the other liquids and showed an increase in mercury vapour concentration with log t.

BIO-PROBE COMMENT: This present study further documents that submergence in water does not prevent the bioavailability of mercury, whatever the source of the mercury. Perhaps the dental profession can now advocate the saturation of all U.S. waters with Mercovap or photographic fixer solution in order to guarantee that the mercury released from dental amalgam in waste water will not be a hazard to the environment!

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Warfvinge, K; Hua, J; Lögdberg, B.
Mercury distribution in Cortical Areas and Fiber Systems of the Neonatal and Maternal Adult Cerebrum After Exposure of Pregnant Squirrel Monkeys to Mercury Vapor.

ABSTRACT:
Pregnant squirrel monkeys were exposed 5 days/week to mercury vapor at a concentration of 0.5 mg Hg/m3 air for 7 hr/day, or at 1 mg Hg/m3 air for 4 or 7 hr/day. The calculated total mercury absorption ranged between 0.8 and 5.4 mg (range of daily absorption 0.04-0.07 mg). The mercury concentration in the cerebral occipital lobe of the offspring ranged between 0.20 and 0.70 micrograms/g tissue, and in the mothers between 0.8 and 2.58 micrograms/g tissue.

Mapping of the distribution of mercury in the neocortical layers of the maternal brains revealed that the pyramidal cells contained more visualized mercury than the other neurons. In addition, the mapping disclosed that the deeper the pyramidal cells were situated the more mercury they contained. In the offspring brains, no laminar distribution pattern was found. In the hippocampal formation, the pyramidal cells again contained more mercury than the other neurons. By contrast, the stratum granulosa of the dentate gyrus was always devoid of visualized mercury. The claustrum and the amygdaloid complex always contained mercury. In the fiber systems, the offspring brains contained more mercury than the adult brains. Mercury was found in both glial cells and neurons both in the cortical areas and in the fiber systems.

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Falnoga, I; Mrhar, A; Karba, R; Stegnar, P; Skrebling, M; Tušek-Znidarić M.
Mercury Toxicokinetics in Wistar Rats Exposed to Elemental Mercury Vapour: Modeling and Computer Simulation.

ABSTRACT:
The kinetics of total mercury (Hg) absorption, distribution and elimination in Wistar rats exposed for long periods to elemental mercury vapour (Hg vapor) in the Idrinja mercury mine were studied. From the experimental data base a compartmental model was built as a framework for experimental data interpretation and prediction of organ mercury levels under different conditions. Using the model the exposures of rats under conditions compa-
rable to those of professionally exposed workers (mercury miners, workers in the chloralkali industry) and individuals with amalgam fillings were simulated.

Alexidis, AN; Rekka, EA; Kourounakis, PN.
Influence of Mercury and Cadmium Intoxication on Hepatic Microsomal CYP2E and CYP3A Subfamilies.

ABSTRACT:
The effects of subchronic mercuric acetate and of acute mercuric acetate and cadmium chloride administration to rat hepatic microsomal protein and total cytochrome P450, as well as on p-nitrophenol hydroxylase (CYP2E) and erythromycin N-demethylase (CYP3A) activities were examined.

It was found that $\text{Hg}^{2+}$ and $\text{Cd}^{2+}$ intoxication resulted in a significant decrease of total cytochrome P450 content. Acute $\text{Hg}^{2+}$ and $\text{Cd}^{2+}$ exposure decreased microsomal protein level. These metals also reduced CYP2E1 activity, while they did not seem to alter CYP3A1-mediated drug metabolism. This effect on CYP2E1 may be connected to free radical generation during $\text{Hg}^{2+}$ and $\text{Cd}^{2+}$ intoxication.

Investigation is in progress using more P450 markers for elucidation of the effect of $\text{Hg}^{2+}$ and $\text{Cd}^{2+}$ on P450 activities.

BIO-PROBE COMMENT: The cytochrome P450 enzymes constitute an important body mechanism for combating harmful materials.

Klein, CL; Kohler, H; Kirkpatrick, CJ.
Increased Adhesion and Activation of Polymorphonuclear Neutrophil Granulocytes to Endothelial Cells under Heavy Metal Exposure in Vitro.

ABSTRACT:
Heavy metals have been implicated in the mechanisms of endothelial damage. Influences of heavy metal ions on diverse cell types have been studied using a variety of in vitro and in vivo methods. Polymorphonuclear neutrophil granulocytes (PMNs) have physiological and pathological functions, including the modulation of adhesion to and destruction of endothelial cells (ECs).

PMNs were studied during interaction with human umbilical vein ECs under exposure to zinc, nickel and cobalt using an in vitro model. We studied adhesion processes with the help of a computer-controlled image-analyzing system and examined the activation of PMNs by quantification of leukotriene B4 (LTB4) release. The biphasic effects of the valuated heavy metals on PMN-EC adhesion, with stimulation at very high and very low molar concentrations, were observed.

The release of LTB4 by PMNs increased during exposure to very low metal concentrations. The initiation of these important pathogenetic mechanisms of inflammation at very low metal ion concentrations, which give no morphologic changes, must be regarded as potentially significant with respect to the toxic effects of heavy metals.

BIO-PROBE COMMENT: Damage to the inner lining of blood vessels (endothelium) is widely regarded to be the initial step in the disease process that leads to cardiovascular disease. Although mercury was not included in this study, it is a heavy metal that has previously been shown to cause endothelial damage. The three metals examined in this study (nickel, cobalt and zinc) are all used in dental restorative materials. Research, published in peer-reviewed dental journals, has demonstrated the release and bioavailability of nickel (and mercury). Cardiovascular disease has become widespread only since the 1920's, about the time of increased use of heavy metals in dental therapy and long after humans consumed eggs, meat, milk, butter and cheese.

Yuan, Y; Atchison, WD.
Comparative Effects of Inorganic Divalent Mercury, Methylmercury and Phenylmercury on Membrane Excitability and Synaptic Transmission of CA1 Neurons in Hippocampal Slices of the Rat.

ABSTRACT:
Comparative effects of inorganic mercury ($\text{Hg}^{2+}$), methylmercury (MeHg) and phenylmercuric acetate (PMA) on central synaptic transmission were examined by recording field potentials from CA1 neurons of rat hippocampal slices before and after acute bath application of mercurials at 20 and 100 microM.

At 100 microM, $\text{Hg}^{2+}$ decreased the amplitude of population spikes (PSs) to complete block; average time to block was 25 ± 4 min. Application of 20 microM $\text{Hg}^{2+}$ for 120 min gradually decreased PS amplitude to 33% of control. Effects of $\text{Hg}^{2+}$ on excitatory postsynaptic potentials (EPSPs) were comparatively slow. Application of 100 microM $\text{Hg}^{2+}$ for 120 min only reduced EPSP amplitude to 60% of control; no complete block occurred, suggesting an effect primarily on the postsynaptic CA1 cell membrane.
In contrast to Hg\(^{2+}\), MeHg at 20 and 100 microM first increased amplitudes of PSs and EPSPs significantly and then decreased both to complete block. Average times to block of PSs and EPSPs by 100 microM MeHg were 41 ± 4 and 42 ± 4 min, respectively.

PMA caused similar effects on PSs and EPSPs as did MeHg. However, unlike MeHg, the increased amplitudes of PSs and EPSPs by PMA were not statistically significant. At 20 microM, PMA appeared to be more effective at blocking PSs and EPSPs than were Hg\(^{2+}\) and MeHg.

Washing slices with artificial cerebrospinal fluid containing 1 mM D-penicillamine completely reversed the effects of Hg\(^{2+}\) on PSs and EPSPs and effects of MeHg on EPSPs in 90 min, but only partially reversed the effects of MeHg on PSs. D-penicillamine could reverse neither the effects of PMA on PSs nor EPSPs.

It is concluded that these perturbations produced damage to the associated physiological functions leading to CNS dysfunctions.

**BIO-PROBE COMMENT:** This study demonstrates that at equal doses, inorganic mercury is at least as neurotoxic as is methylmercury, although the mechanism of action may differ somewhat. D-penicillamine is a mercury chelating agent, which has a greater potential for adverse side effects than either DMPS or DMSA. Its potential for possibly reversing the neurotoxic effects of mercury is very encouraging.

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**ABSTRACT:**

PURPOSE: To study the long-term MR findings in seven patients with Minamata Disease.

METHODS: All patients examined were affected after eating daily considerable amounts of the methylmercury-contaminated seafoods from 1955 through 1958 and showed typical neurologic findings. T1- and T2-weighted images were obtained in axial, coronal, and sagittal sections.

RESULTS: The visual cortex, the cerebellar vermis and hemispheres, and the postcentral cortex were significantly atrophic. The visual cortex was slightly hypointense on T1-weighted images and hyperintense on T2-weighted images, probably representing the pathologic changes of status spongiosus.

CONCLUSION: MR demonstrated the lesions, located in the calcarine area, cerebellum, and postcentral gyri, which are probably related to three of the characteristic manifestations of this disease; the constriction of the visual fields, ataxia, and sensory disturbance, respectively.

**BIO-PROBE COMMENT:** Although this study is of neuropathologic damage from methylmercury rather than elemental mercury, the ability to detect mercury damage utilizing magnetic resonance could have important significance.

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**ABSTRACT:**

The present investigation was undertaken to identify commonly occurring foreign material in postendodontic periapical granulomas and cysts. Twenty-nine biopsies from such lesions with observed foreign material were routinely processed, stained with H & E, von Kossa and Calcofluor White and investigated by light, polarization and fluorescence microscopy. Applying back-scattered SEM images, the foreign material was subjected to energy dispersive X-ray analysis. Four groups of foreign material were observed:

1. Black/brownish fragments and yellow/brown granules containing Au, Ag, Cu, Hg, Sn and Zn compatible with amalgam.

2. Fine black/brown/yellow granules compatible with endodontic sealer components revealing Ag, Ba, Bi, Cu, S, Ti and Zn.

3. Basophilic fragments compatible with Ca salts from Ca(OH)\(_2\) extruded periapically and containing Ca and P.

4. Elongated/rounded/oval/kidney-shaped, colourless to slightly basophilic, birefringent structures revealing C and O and with a slit-like central canal and a bright, pale-blue fluorescence specific for cellulose.

**BIO-PROBE COMMENT:** This study clearly demonstrates the ability of materials used in endodontic therapy to elicit inflammatory responses periapically. In the 29 specimens, the foreign material was identified to represent amalgam components in 9 cases, endodontic sealer components in 9 cases, and cellulose fibers from paper points in 11 cases.

In the amalgam cases, the authors did not specify the source as retrograde amalgam fillings. Although this might be assumed to be the case, the presence of gold (Au) would seem to be confusing.
In the endodontic sealers, the presence of heavy metals (silver, barium, bismuth, copper and titanium) is most interesting. Although the authors stated that in some of the cases the inflammatory response was "suspected to be due to extrusion of Ca(OH)2 beyond the apical foramen", they also stated: "Amazingly, no reports seem to exist on the chemical fate of Ca(OH)2 in tissues. The compound is, however, easily soluble and as Ca in tissues usually exists as Ca-phosphates and Ca(CO)3." They did site one report claiming that calcium hydroxide caused an inflammatory response in experimental material, resulting in necrotic tissue that later dissolved.

It might be concluded, therefore, that if calcium hydroxide were extruded past the apical foramen, the inflammatory response that might result would resolve. It should be further noted that no claims of adverse effects to calcium phosphate or calcium carbonate were made. Further, the solubility of calcium hydroxide in periradicular tissues does not mean that the same occurs if the calcium hydroxide were inside of devital teeth (canals or tubules) as those areas are devoid of blood supply.

The authors were particularly concerned about the presence of cellulose in the tissues, which was derived from paper points. They stated: "Of serious concern is the fact that cellulose is not normally broken down by human immune systems, and, contrary to starch granulomas, lesions induced by cellulose fibers will not resolve with time."; and: "In our opinion, cellulose fibers derived from endodontic paper points must bear heavy responsibility for the development of these lesions. The vivid, prolonged granulomatous reaction emphasizes the possible hazards in any clinical application of cellulose or cellulose-containing products (such as disposable surgical gowns and drapes, gauze and gingival retraction cords)."

Shimojo N; Arai Y.
Effects of exercise training on the distribution of metallic mercury in mice.

**ABSTRACT:**
1. The purpose of this study was to correlate exercise induced changes of antioxidant enzymes with the distribution of mercury after mercury vapour exposure in mice. 2. Exercise training consisted of swimming (1 h/day for 5 days/week) for 9 weeks. After 9 weeks of training, swim-trained mice showed significantly elevated levels of catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GSHpx) in their red blood cells, CAT and GSHpx in their kidneys and SOD in the liver. 3. Exercised mice (EX) and non-exercised mice (N.Ex) were exposed to mercury vapour (3.5 mg m\(^3\)) for 1 hour. Mercury concentrations were assayed in the blood, brain, heart, lungs, liver and kidneys along with the mercury content of the entire body. The whole body mercury content showed no significant difference in any measurement (immediately, 24 h and 48 h. after mercury exposure) between the Ex and N.Ex groups. Mercury concentrations in the Ex group were significantly higher than the N.Ex group in the heart, whole blood, red blood cells and the brain at 25 and 49 h; and in the plasma and kidneys at 24 h. 4. It was concluded that exercise training is a factor in distribution changes of mercury after exposure to mercury vapour, though it is not a factor in the total absorption and excretion of mercury. **BIO-PROBE COMMENT:** If extrapolated to humans, it would indicate that individuals with a mouth full of amalgams, who exercise, are at much greater risk of heart disease and mental illness than individuals who are mercury-free performing the same degree of exercise.

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FORUM

IAOMT - 11TH ANNUAL SCIENTIFIC SYMPOSIUM

Date: 15-17 September 1995.
Hotel: "Hotel Atop the Bellevue," 1415 Chancellor Court, Philadelphia, PA. 19102. Room Reservations: $120.00/night. Call (800) 221-0833 [Specify IAOMT]. Airport/Hotel shuttle: $8.00 (one way).

This hotel is located in the center of the upscale Philadelphia historical district and is a member of the elite "Preferred Hotels and Resorts Worldwide." The IAOMT room rate is extraordinary, but a limited number are available at that rate. YOU MUST MAKE YOUR-RESERVATIONS as early as possible!

Program [Partial Listing]:
- Murray J. Vimy, DMD = "Scientific Update on Dental Amalgam."
- Richard Passwater, Ph.D. = "Antioxidants' Role in the Prevention and Treatment of Periodontal Disease."
- Harold Gelb, DMD = "Role of TMJ Disorders in Facial Pain."
- Jerry Bouquot, DDS = "Role of NICO’s and Root Canal Teeth in Facial Pain."
- Robert E. McMahon, DDS = "Treatment of NICO’s and Failed Root Canal Teeth."
- Aaron J. Rynd, Ph.D. = "The Discipline Hearing or Trial for Negligence."
- Michael F. Ziff, DDS = "Documentation Defending Promotion of the Amalgam Controversy."