SB

90

Consumers Dental Choice Project

April 1997

Alaska Legislators
Alaska State Capitol Building
Juneau, Alaska 99801

I strongly support the add.. .5 AS 08.36 that will allow a dentist to recommend the removal and replacement of dental amalgam restorations with another approved dental material and not be faced with the threat of dental board sanction.

Yours very truly

Walter J. Hickel

Governor Walter Hickel

Consumers Dental Choice Project

April 1997

Alaska Legislators
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Juneau, Alaska 99801

Dental Statute Additions

"Sec. 5. AS 08.36.315 is amended by adding a new subsection to read:

(b) Notwithstanding other provisions of this section, the board may not impose a disciplinary sanction on a dentist based solely on the grounds that the dentist removed or placed, or recommended the removal or placement of, a professionally recognized restorative material for a patient in the absence of demonstrable physical harm to the patient.

"Sec. 6. AS 08.36 is amended by adding a new section to read: **Sec. 08.36.355. Patient's right to choice in restorative material.** This chapter may not be construed to deprive a dental patient to the right to choose or replace a professionally recognized restorative material.

Dental Amalgam Restorations

Dental amalgam restorations consist of 50% mercury, 35% silver, 13% tin, 2% copper, and a trace amount of zinc. After an amalgam is installed in a tooth it slowly releases mercury and the other metals into the body. Mercury is the single most toxic non radioactive metal; the most minute amount damages human cells. This challenges systemic functions of every individual and of developing fetuses and can lead to health problems and birth defects. Mercury leakage and its subsequent pathophysiologic effects are slow processes. Most health problems caused by mercury poisoning are perceived many years after amalgams are installed.

Dentists have been installing amalgam restorations in patients teeth for more than 150 years. Ever sense they were first installed there has been an issue as to whether dental amalgam restorations cause adverse health effects.

Science Documenting Health Effects

In 1984 a group of conscientious dentists realized there was a need to scientifically explore the safety of amalgam restorations. Since then many renowned medical scientists at universities around the world have researched possible pathophysiologic effects associated with mercury leaking from amalgam restorations. Consequently there are a growing number of scientific studies that document pathophysiologic health effects associated with the amalgam. Some documented effects are summarized below.

- each amalgam leaks about 2 to 3 ug of mercury per day (i.e. from the amalgam into the body),
- more than 2/3 of excretable mercury in humans is derived from amalgams,
- mercury crosses the placenta into the tissue of a developing fetus,
- mercury is capable of inducing autoimmunity,
- mercury immediately and continually challenges the kidney's functioning,
- mercury can enhance the prevalence of multiple antibiotic resistant intestinal bacteria,
- people exposed to mercury on a sustained bases are at risk to lowered fertility,
- elevated levels of mercury are found in the brain tissue of Alzheimer's disease patients. In an on going study at the University of Kentucky, documentation is being developed which irrefutably connects many aspects of Alzheimer's disease to mercury leaking from dental amalgams.

Dental Board Disciplinary Action

The American Dental Association's (ADA) code of ethics makes the removal of serviceable mercury amalgam restorations for health reasons an issue of ethical conduct. According to the ADA's code of ethics a dentist who acknowledges that mercury amalgam restorations are toxic and recommends their removal for health reasons has acted unethically ("...the removal of amalgam restorations from the non-allergic patient for the alleged purpose of removing toxic substances from the body when such treatment is performed solely at the recommendation of the dentist is improper and unethical...." ADA Resolution 42H-1986. Transaction 1986:536)

On the bases of the ADA's code of ethics, dental boards in other states have taken disciplinary action against dentists who have practiced their profession in accordance with current scientific knowledge and their conscience. The disciplinary action has ranged from restrictions placed on their practice to the loss of license. Today, more than 20 dentists in other states are under board review who remove amalgams for health reasons. The above dental statute additions will protect dentists in Alaska who want to inform patients of health risks associated with mercury leaking from amalgam restorations and then proceed with appropriate dental care if the patient desires. It is our belief that these dental statute additions will encourage a growth of both amalgam restoration removal and installation of the biological compatible composite restorations. With these dental statute additions our society will be healthier and its long term medical cost reduced.

More detailed information about "the dental amalgam issue" is presented on the world wide web at amalgam.org. We thank you in advance for considering this request. Please call if you have any questions.

Yours very truly,

G. Scott Crowther, P. E.

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HB1187_L.007

HOUSE COMMITTEE OF REFERENCE REPORT

Chairman of Committee Date

Committee on State, Veterans, and Military Affairs.

After consideration on the merits, the Committee recommends the following:

HB 97-1187 be amended as follows, and as so amended, be referred to the Committee of the Whole with favorable recommendation:

Amend printed bill, strike everything below the enacting clause, and substitute the following:

"SECTION 1. 12-35-118 (1) (ff), Colorado Revised Statutes, 1991 Repl. Vol., as amended, is amended, and the said 12-35-118 is further amended BY THE ADDITION OF A NEW SUBSECTION, to read:

12-35-118. Causes for denial of issuance or renewal - suspension or revocation of licenses - other disciplinary action - unprofessional conduct defined - immunity in professional review. (1) The board may deny the issuance or renewal of, suspend for a specified time period, or revoke any license provided for by this article or may reprimand, censure, or place on probation any licensed dentist or dental hygienist after notice and hearing, which may be conducted by an administrative law judge, pursuant to the provisions of article 4 of title 24, C.R.S., or it may issue a letter of admonition without a hearing (except

that any licensed dentist or dental hygienist to whom such a letter of admonition is sent may, within thirty days after the date of the mailing of such letter by the board, request in writing to the board a formal hearing thereon, and the letter of admonition shall be deemed vacated, and the board shall, upon such request, hold such a hearing) for any of the following causes:

(ff) Practicing outside the scope of ~~legitimate~~ dental or dental

hygiene practice.

(1.7) (a) NOTHING IN THIS SECTION SHALL BE CONSTRUED TO DEPRIVE ANY DENTAL PATIENT OF THE RIGHT TO CHOOSE OR REPLACE ANY PROFESSIONALLY RECOGNIZED RESTORATIVE MATERIAL, NOR TO PERMIT DISCIPLINARY ACTION AGAINST A DENTIST SOLELY FOR REMOVING OR PLACING ANY PROFESSIONALLY RECOGNIZED RESTORATIVE MATERIAL.

(b) NOTHING IN PARAGRAPH (a) OF THIS SUBSECTION (1.7) SHALL BE CONSTRUED TO PREVENT DISCIPLINARY ACTION AGAINST A DENTIST FOR PRACTICING DENTISTRY IN VIOLATION OF ARTICLE 35 OF THIS TITLE.

SECTION 2. Applicability. This act applies to all dentists licensed to practice dentistry pursuant to article 35 of title 12, Colorado Revised Statutes, who perform dental procedures that involve placement or replacement of dental restorative materials on and after the effective date of this act.

SECTION 3. Effective date. This act shall take effect upon the expiration of the period allowed for submitting a referendum petition pursuant to article V, section 1 (3) of the state constitution, unless a referendum petition is filed against this act within such period, in which case this act, if approved by the people, shall take effect on the date of the official declaration of the vote thereon by proclamation of the governor.".

** *** ** *** **

www.amalgam.org

The Dental Amalgam Issue
prepared on April 1997 by the
Consumer Dental Choice Project
A Project of the National Institute for Science, Law and Public Policy
1424 16th Street, NW Suite 105
Washington, D.C. 20036

This display presents the following information regarding the dental amalgam issue.

I)Introduction of the Issue

In dental terminology *"silver"* is a euphemism for an amalgam which dentists place in our teeth as restoration material. Dental amalgam restorations consist of mercury, silver, tin, copper, and a trace amount of zinc. After an amalgam is installed in a tooth it slowly releases mercury and other metallic vapor into the body. Mercury is the single most toxic non radioactive metal; the most minute amount damages human cells. This challenges systemic functions of every individual and of developing fetuses and can lead to health problems and birth defects. Mercury leakage and its subsequent pathophysiologic effects are slow processes. Most health problems caused by mercury poisoning are perceived many years after amalgams are placed.

II)Historical Overview of Mercury Use in Dentistry

Lorscheider, F.L., Vimy, M.J., and Summers, A.O. *"Mercury Exposure from Silver Tooth Fillings: Emerging Evidence Questions a Traditional Dental Paradigm."* FASEB Journal (April 1995).

As early as the 7th century, the Chinese used a "silver paste" containing mercury (Hg) to fill decayed teeth. Throughout the Middle Ages, alchemists in China and

Europe observed that this mysterious silvery liquid, extracted from cinnabar ore, was volatile and would quickly disappear as vapor when mildly heated. Alchemist were fascinated that at room temperature Hg appeared to "dissolve" powders of other metals such as silver, tin, and copper. By the early 1800's the use of a Hg/silver paste as a tooth filling material was being popularized in England and France and it was eventually introduced into North America in the 1830s. Some early dental practitioners expressed concerns that the Hg/silver mixture (amalgam) expanded after setting, frequently fracturing the tooth or protruding above the cavity preparation, and thereby prevented proper jaw closure. Other dentists were concerned about mercurial poisoning, because it was already widely recognized that Hg exposure resulted in many overt side effects, including dementia and loss of motor coordination. By 1845, as a reflection of these concerns, the American Society of Dental Surgeons and several affiliated regional dental societies adopted a resolution that its members sign a pledge not to use amalgam. Consequently, during the next decade some members of the society were suspended for the malpractice of using amalgam. But the advocates of amalgam eventually prevailed and membership in the American Society of Dental Surgeons declined, forcing it to disband in 1856. In its place arose the American Dental Association (ADA), founded in 1859, based on the advocacy of amalgam as a safe and desirable tooth filling material. Shortly thereafter, tin was added to the Hg/silver paste to counteract the expansion properties of the previous amalgam formula.

There were compelling economic reasons for promoting dental amalgam as a replacement for the other common filling materials of the day such as cement, lead, gold, and tinfoil. Amalgam's introduction meant that dental care would now be within the financial means of a much wider sector to the population, and because amalgam was simple and easy to use, dentists could readily be trained to treat the anticipated large number of new patients. By 1895, the dental amalgam mixture of metals had been modified further to control for expansion and contraction, and the basic formula has remained essentially unchanged since then. Scientific concerns about amalgam safety initially surfaced in Germany during the 1920's, but eventually subsided without a clear resolution. At the present time, based on 1992 dental manufacturer specifications, amalgam (at mixing) typically contains approximately 50% metallic Hg, 35% silver, 9% tin, 6% copper, and a trace of Zinc. Estimates of annual Hg usage by U.S. dentists range from approximately 100,000 kg in the 1970's to 70,000 kg today. Hg fillings continue to remain the material preferred by 92% of U.S. dentists for restoring posterior teeth. More than 100 million Hg fillings are placed each year in the U.S. Presently, organized dentistry has countered the controversy surrounding the use of Hg fillings by claiming that Hg reacts with the other amalgam metals to form a "biologically inactive substance" and by observing that dentists have not reported any adverse side effects in patients. Long-term use and popularity also continue to be offered as evidence of amalgam safety.

III)Summary of Scientific Studies

III a)In 1984 a group of contentious dentists formed the International Academy of Oral Medicine and Toxicology (IAOMT). One of their objectives was to scientifically explore the safety of amalgam restorations. Since 1984 members of the IAOMT have inspired many renowned medical scientists at universities around the world to research possible pathophysiologic effects associated with mercury leaking from amalgam restorations. Consequently there are a growing number of

scientific studies that document pathophysiologic effects associated with the amalgam. Some of the more paramount scientific studies are summarized below.

III b)Lorscheider, F.L., Vimy, M.J., and Summers, A.O. *"Mercury Exposure from Silver Tooth Fillings: Emerging Evidence Questions a Traditional Dental Paradigm."* FASEB Journal (April 1995).

SUMMARY This document reviews results of animal and human studies of pathophysiologic effects related to mercury leaking from amalgam restorations. Some pertinent points presented include:

- every amalgam leaks about 15 ug of mercury per day,
- more than 2/3 of excretable mercury in humans is derived from amalgams,
- mercury crosses the placenta into the tissue of a developing fetus,
- mercury is capable of inducing autoimmunity,
- mercury immediately and continually challenges the kidney's functioning,
- murcury can enhance the prevalence of multiple antibiotic resistant intestinal bacteria,
- people exposed to mercury on a sustained bases are at risk to lowered fertility,
- elevated levels of mercury are found in the brain tissue of Alzheimer's disease patients.

III c)Vimy, M.J., Y. Takahashi, and F.L. Lorscheider *"Maternal-fetal distribution of mercury (203Hg) released from dental amalgam fillings."* Am. J. Physiol. 258 (Regulatory Integrative Comp. Physiol. 27): R939-R945 (1990).

ABSTRACT In humans, the continuous release of Hg vapor from dental amalgam tooth restorations is markedly increased for prolonged periods after chewing. The present study establishes a time-course distribution for amalgam, Hg in body tissues of adult and fetal sheep. Under general anesthesia, five pregnant ewes had twelve occlusal amalgam fillings containing radioactive 203Hg placed in teeth at 112 days gestation. Blood, amniotic fluid, feces, and urine specimens were collected at 1- to 3-day intervals for 16 days. From days 16-140 after amalgam placement (16-41 days for fetal lambs), tissue specimens were analyzed for radioactivity, and total Hg concentrations were calculated. Results demonstrate that Hg from dental amalgam will appear in maternal and fetal blood and amniotic fluid within 2 days after placement of amalgam tooth restorations. Excretion of some of this Hg will also commence within 2 days. All tissues examined displayed Hg accumulation. Highest concentrations of Hg from amalgam in the adult occurred in kidney and liver, whereas in the fetus the highest amalgam Hg concentrations appeared in the liver and pituitary glands. The placenta progressively concentrated Hg as gestation advanced to term, and milk concentration of amalgam Hg postpartum provides a potential source of Hg exposure to the newborn. It is concluded that accumulation of amalgam Hg progresses in maternal and fetal tissues to a stead state with advancing gestation and is maintained.

III d)Drasch et. al. *"Mercury Burden of Human Fetal and Infant Tissues"* European Journal of Pediatrics (August 1994).

ABSTRACT The total mercury concentrations in the liver (Hg-L), the kidney cortex (Hg-K) and the cerebral cortex (Hg-C) of 108 children aged 1 day- 5 years, and the Hg-K and Hg-L of 46 fetuses were determined. As far as possible, the mothers were interviewed and their dental status was recorded. The results were compared to mercury concentrations in the tissues of adults for the same geographical area. The Hg-K (n=38) and Hg-L (n=40) of fetuses and Hg-K (n=35) and Hg-C (n=35) of older infants (11-50 weeks of life) correlated significantly with the number of dental amalgam fillings of the mother. The toxicological relevance of the unexpected high Hg-K of older infants from mother with higher numbers of dental amalgam fillings is discussed. Conclusion Future discussion on the pros and cons of dental amalgam should not be limited to adults or children with their own amalgam fillings, but also include fetal exposure. The unrestricted application of amalgam for dental restorations in women before and during the child-bearing age should be reconsidered. Abbreviations Hg-C total mercury concentration in the cerebral cortex (ng/g wet weight). Hg-K total mercury concentration in the renal cortex (ng/g wet weight). Hg-L total mercury concentration in the liver (ng/g wet weight).

III e)An on-going study at the University of Kentucky has linked many aspects of amalgam mercury to brain tissue damage found in patients with Alzheimer's Disease. Two abstracts of this study are presented below.

III e1)Lorscheider, F. L., Vimy, M.J., Pendergrass, J.C., Haley, B.E., *"Mercury Vapor Exposure Inhibits Tubulin Binding to GTP in Rat Brain: A Molecular Lesion also Present in Human Alzheimer Brain."* FASEB Journal 9(4): A-3845. FASEB Annual Meeting, Atlanta, Georgia (March 10, 1995).

ABSTRACT Methyl mercury will interact with tubulin causing disassemble of microtubules that function to maintain neurite structure. Numerous reports also establish that mercury vapor (Hg0) is continuously released from "silver" amalgam tooth fillings into mouth air.

In this present study rats were exposed to Hg0 4 hr/day for 0, 2, 7, 14, and 28 days at 250 mcg Hg/m3 air, a concentration present in mouth of humans with large numbers of amalgam fillings. Average rat brain Hg concentrations increased significantly (40-100 fold) with duration of Hg0 exposure.

By day 14 of Hg0 exposure, photoaffinity labeling of the b-subunit of the tubulin dimer with (a32P)8N3GTP in brain hamogenates was decreased 75% , as seen on analysis of SDS-PAGE autoradiograms.

The identical neurochemical lesion of similar magnitude is evident in Alzheimer brain homogenates when compared to human age-matched controls. Since the rate of tubulin polymerization is dependent upon binding of tubulin dimers to GTP, we conclude that chronic inhalation of low-level Hg0 can inhibit polymerization of tubulin essential for formation of microtubules.

III e2)Pendergrass, J., Israel, M., and Haley, B. *"The Deleterious Effects of Low Micromolor Mercury on Important Brain and Cerebrospinal Fluid Proteins"* American Association of Pharmaceutical Scientists, Annual Meeting, Miami, Florida (November 1995).

ABSTRACT Alzheimer's Disease (AD) is the most common cause of adult onset dementia. There is no effective treatment or proven diagnostic indicator of AD. While the etiology and pathogenesis of AD are not known, there have been several

published reports of altered protein-nucleotide interactions.

Our laboratory developed the technique of nucleotide photoaffinity labeling as a method for identifying the nucleotide binding domains of several important enzymes. We have also shown this technique to be very sensitive and reliable tool for identifying changes in nucleotide-proteins interactions when comparing AD brain and CSF (cerebrospinal fluid) to non-demented control tissues. For example, we have shown using 32P8N3GTP and 32P8N3ATP that b-tubulin and creatine kinase (CK) interactions, respectively, are aberrant in AD brain homogenates relative to age-matched neurologic controls. This is despite both proteins being present near control levels, indicating that both tubulin and CK have been modified in the disease state.

Currently, photolabeling technology coupled with high resolution 2-D gels (IEF X SDS-PAGE) has been developed to enhance the ability to detect changes in protein-nucleotide interactions in brain and CSF samples. This approach shows what appears to be specific changes in the 32P8N3ATP photo labeling profile of 2D separated CSF proteins of AD patients versus those of non-demented control CSFs or in CSF of other neurodegenerative diseases.

This technology also shows that exposure of human control brain homogenates to 1-3 microM Hg2+-EDTA complex produces 32P8N3GTP-b-tubulin interactions comparable to that of AD brains.

IV)Patient Reports

IV a)Siblerud, R.L. *"Health Effects After Dental Amalgam Removal"* Journal of Orthomolecular Medicine. Vol. 5, No. 2, (1990).

SUMMARY A Utah dentist provided the names and addresses of approximately 300 people of who had their amalgams removed. A health questionnaire was sent to these people; 86 subjects responded. Eighty (80) % of the subjects reported that they felt better following amalgam removal. Nearly all of the subjects 91% said they were glad their amalgams had been removed and 88% said they would do it again. An increase in happiness and peace of mind was experienced by 58% of the subjects. This evidence suggests that the well being of these subjects improved immensely after amalgam removal.

IV b)Mary Davis editor *"Defense Against Mystery Syndromes"* Chek Printing Co. March 1994

SUMMARY This book presents patient reported case histories, where they associate their health problems to dental amalgam mercury. Case histories include: Chronic Fatigue Syndrome, Seizures, Memory Loss, Migraines, Multiple Allergies, Multiple Sclerosis, Depression, Lupus, Maldigestion, Chemical Sensitivities, Insomnia, Miscarriages, Paralysis, Sinus Problems, Emotional & Mental Disorders, Infertility, Endometriosis, Crohn's Disease, Rashes, Anxiety, Tremors & Spasms, Amyotrophic Lateral Sclerosis, Universal Reactor and many others.....

V)Proper Amalgam Removal

WARNING If you have a serious health problem consult a medical doctor who is informed on proper removal protocols before having your amalgams removed.

IAOMT Standards of Care, Preferred Procedure, *"Reducing Mercury Vapor*

Exposure for the Patient During Amalgam Removal." (September 1992)

The IAOMT has currently established the following amalgam removal protocols. If these protocols are followed then the amount of mercury released during amalgam removal is reduced.

- place a rubber dam around the tooth to isolate it from the body,
- provide an alternative source of air to the patient,
- place a saliva ejector under the dam to remove mercury vapor that penetrates the latex,
- use high volume evacuation with isolate attachment,
- section amalgams and remove in as large pieces as possible,
- remove and properly dispose of rubber dam and mercury after amalgam removal.

Other amalgam removal precautions in addition to the protocols listed above include:

- remove no more than two amalgams per appointment,
- time amalgam removal appointments at least one month apart.
- administer intervenes Vitamin C before removal (Hg has a greater affinity to Vitamin C that is present in the blood than it does for body tissue),

VI)Amalgam Removal Studies

VI a)This study measures the mercury level when amalgams are removed not following the protocols presented above in V.

Molin, M., Bergman B., Marklund, S.L., Schutz, A., Skerfving, S., *"Mercury, Selenium, and Glutathione Peroxidase Before and After Amalgam Removal in Man"* Acta Odontal Scandinavia; 48:189-202. Oslo. ISSN 0001-6357 (1990).

ABSTRACT In 10 healthy persons all amalgam fillings were replaced with gold inlays. Blood and urinary levels were measured on 10 occasions during a 4-month period before and a 12-month period after amalgam removal. These variables were also measured three times in 10 healthy controls. A strong statistically significant relation was found between plasma mercury values and both the total number of amalgam surfaces ($r=0.71$, $p=0.0006$) and the total surface area of the fillings ($r=0.73$, $p=0.004$). In the immediate post removal phase plasma mercury rose three- to four-fold, whereas the urinary and erythrocyte mercury rose about 50%. These peak values declined to the pre removal level at about 1 month after removal. Twelve months after the removal plasma and urinary mercury levels were reduced to 50% and 25%, respectively, of the initial values for the experimental group. Apart from the significantly lower plasma selenium values 5 and 10 days after removal no significant differences were found with regard to plasma selenium or erythrocyte glutathione peroxidase either within or between the experimental and the control groups. A large number of supplementary biochemical analyses did not show any influence on organ functions or any differences between the groups before or after the amalgam removal. Amalgam fillings considerably contributed to the plasma and urinary mercury levels.

VI b)This study measures the mercury level when amalgams are removed following the protocols presented above in V.

Molin, M., Berglund, J.R., Mackert, J.R., *"Kinetics of Mercury in Blood and Urine after Amalgam Removal."* J. Dental Research, 74:420,IADR abstract 159, (1995).

ABSTRACT Even through a number of studies have not been able to reveal any correlation between subjective symptoms and amalgam load there still are speculations whether patients with subjective symptoms related by the patients themselves to their amalgam fillings could have a changed pattern of elimination of mercury. The aim of the present investigation was to study the elimination half-time of mercury in plasma, erythrocytes and urine over an extended period of time after amalgam removal in a group of 10 patients with subjective symptoms by the patients themselves referred to their amalgam fillings and a group of 8 healthy subjects. The average number of occlusal and total amalgam surfaces in the patient group were 13.0 (range 4-20) and 44.4 (range 24-68), respectively. Corresponding figures in the control group were 12.9 (range 10-16) and 40.9 (range 24-63).

The amalgam removal using rubber dam, water spray cutting and high volume vacuum evacuator, was carried out at one and the same time. Blood and urine samples were collected at two occasions before the amalgam removal, then blood was collected at thirty two occasions and urine at forty three occasions during the following year. The mercury content was analyzed by CVAAS technique.

The measured P-, Ery- and U-Hg concentrations before amalgam removal were slightly higher in the control group 6.4+3.3 nmol/L, 19.4+6.6 nmol/L, and 2.7+1.3 nmol/nmol creatinine respectively than in the symptom group 5.6+1.8 nmol/L, 14.8+8.8 nmol/L, and 1.6+0.9 nmol/nmol creatinine respectively.

The Hg-concentrations did not significantly increase in the two groups after amalgam removal. Six days after the removal the plasma mean concentration was significantly decreased at P level and ten days after the decrease was at a permanent P level. The mean Ery-Hg level was significantly decreased after eleven days (p), a level that remained stable for the rest of the year. The mean U-Hg level was significantly decreased one month after the removal and after six months the mean level was reduced with 80 % compared to the initial level in both groups.

The conclusion to be drawn for the present study is that the symptom group did not have a changed pattern of elimination of mercury compared to the healthy group.

VII)Pregnancy Precaution

The continuous release of mercury from amalgam restorations may be responsible for a portion of birth defects seen today. While you might wish to avoid any further exposure to this material by having your fillings removed immediately, an unborn baby is very much at risk to mercury in its mother's blood. When amalgam filling are removed or an amalgam-filled tooth is extracted, a surge of mercury may be released into the bloodstream. So women who are pregnant should not have amalgam fillings removed. Women should have their amalgam fillings removed at least one year in advance of when they intend to become pregnant and discuss the risk with an informed medical doctor or dentist.

VIII)American Dental Association Positions'

VIII a)Journal of the American Dental Association (April, 1990).

The strongest and most convincing support we have for the safety of dental amalgam is the fact that each year more than 100 million amalgam fillings are placed in the United States. And since amalgam has been used for more than 150 years, literally billions of amalgam fillings have been successfully used to restore decayed teeth.

VIII b)The Superior Court of the State of California Case No. 718228, Demurrer (October 22, 1992).

The American Dental Association (ADA) owes no legal duty of care to protect the public form allegedly dangerous products used by dentists. The ADA did not manufacture, design, supply or install the mercury-containing amalgams. The ADA does not control those who do. The ADA's only alleged involvement in the product was to provide information regarding its use. Dissemination of information relating to the practice of dentistry does not create a duty of care to protect the public from potential injury.

VIII c)The American Dental Association's (ADA) code of ethics makes the removal of serviceable mercury amalgam restorations an issue of ethical conduct. In the ADA's point of view, it is ethical for a dentist to place mercury amalgam restorations in a patient and claim their safety. However, according to the ADA's code of ethics a dentist who acknowledges that mercury amalgam restorations are toxic and recommends their removal has acted unethically ("...the removal of amalgam restorations from the non-allergic patient for the alleged purpose of removing toxic substances from the body when such treatment is performed solely at the recommendation of the dentist is improper and unethical..." ADA Resolution 42H-1986. Transaction 1986:536) On the bases of the ADA's code of ethics, state dental boards have taken disciplinary action against mercury free dentists who have practiced their profession in accordance with current scientific knowledge and their conscience. The disciplinary action has ranged from restrictions placed on their practice to the loss of license.

IX)Amalgam Lawsuit

Bio-probe Newsletter, Volume 12, Issue 6 (November 1996).

After considering evidence and extensive arguments from attorneys for the plaintiff and defendants, the judge in the California case of Tolhurst v. Johnson & Johnson Consumer Products, Inc. ruled that it is not generally accepted in the scientific community that mercury from amalgam dental fillings is capable of causing Guillain Barre' Syndrome, the affliction allegedly suffered by plaintiff Tolhurst. The judge therefore suppressed any evidence at the trial demonstrating that mercury was the cause of the plaintiff's illness. The evidentiary hearing was held in response to a defense motion based on the *Frye* rule. This rule requires a plaintiff to demonstrate that the scientific tests, techniques, and methods on which he/she intends to rely at trial are "sufficiently established to have gained general acceptance in the particular field in which it belongs." The test emphasizes a comparison of the members of the relevant scientific community who do or do not consider the proposed scientific test, method, or technique as valid and reliable.

X)Government Phase Outs

In the interest of protecting their citizens' health, Sweden, Germany, Denmark,

Austria, Finland and Canada have recently taken steps to limit and phase out the use of amalgam restorations.

The United States of America Food and Drug Administration has not recently reviewed the safety of amalgam restorations.

XI)To Take Action

To participate in this great work please write or speak to your congressman or other government officials and request that they review and investigate the dental amalgam issue.

XII)Organizations

XII a)Dental Amalgam Mercury Syndrome (DAMS)

A support group of dental mercury victims who feel a strong obligation to inform fellow citizens of the health hazards associated with amalgam fillings. Most of the dedicated individuals involved in DAMS are victims and volunteers. DAMS can be reached at:

DAMS, Inc.
1701 Buffalo Dancer Trail, NE
Albuquerque, NM 87112

XII b) International Academy of Oral Medicine and Toxicology (IAOMT)

If you are a mercury-free dentist or are contemplating going mercury-free, you need to join the IAOMT. The IAOMT has helped fund or has been the catalyst for much of the current scientific research demonstrating that dental amalgam is not the benign dental material that 150 years of use and the ADA would like you to believe. Furthermore, the IAOMT is doing something about Standards of Care and Protocols that protect you, your staff and the patient. For membership contact:

IAOMT
P.O. Box 608531
Orlando, FL 32860-8531

XII c)American College of Advancement in Medicine (ACAM)

An association of doctors who practice alternative or complementary medicine. Most of them also practice celation therapy, which is used to detoxify the body.

ACAM
P.O. Box 3427
Laguna Hills, CA 9265

XI d) Consumer Dental Choice Project (CDCP)

A project of the National Institute for Science, Law, and Public Policy created to "level the play field " between the powerful state Dental Boards and all licensed dentists, whether or not mercury-free. Furthermore, CDCP has grown to involve Governors, Attorney Generals, and Directors of Health in the fight to allow dentists to practice which ever way is safe, effective, and within their professional opinion.

CDCP
1424 16th Street, NW Suite 105

Washington, D.C. 20036

XIII)Books Available

Bio-Probe Inc. has several books pertaining to dental amalgam mercury. They advertise these books on the world wide web at http://www.bioprobe.com.

XIV)Newsletters

A quarterly International DAMS Newsletter is published at DAMS, Inc., 1701 Buffalo Dancer Trail, NE, Albuquerque, NM 87112. The subscription price is $25.00 per year.

The Bio-Probe Newsletter is published bi-monthly. Editorial office is at 5508 Edgewater Dr., Orlando, FL 32810. The subscription price is $65.00 per year for USA and Canadian subscribers, and $85.00 per year for other countries. Postage paid at Orlando.

XV)Hippocratic Oath

"...I will prescribe regimen for the good of my patients according to my ability and my judgment and never do harm to anyone. To please no one, will I prescribe a deadly drug nor give advice which may cause his death. If I keep this oath faithfully, may I enjoy my life and practice my art, respected by all men and in all times; but if I swerve from it or violate it, may the reverse be my lot."

Be kind and compassionate to one another, forgiving each other, just as in Christ God forgave you. Ephesians 4:32.

IAOMT
Standards of Care

Preferred Procedure

Reducing Mercury Vapor Exposure for the Patient During Amalgam Removal

Preferred Procedure Code	AGPTHYG.1
Received	9/4/92
Scientific Review	9/4/92
Standard of Care Review	9/6/92
IAOMT Board Review	9/27/92
Provisional Approval	
Approval	9/27/92
No Opinion	
No Approval	

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Are you a member of IAOMT? _XX_ **Yes** ____ **No** **Non-member Application Fee: $25.00.**

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1. **Name of preferred procedure:** Reducing Mercury Vapor Exposure to the Patient During Amalgam Remov

2. **Alternative name(s) of preferred procedure:**

3. **What is this preferred procedure related to?** ____ **Medicine** _XX_ **Dentistry**

4. **Is this preferred procedure a .....?** ____ **Product** _XXX_ **Procedure** ____ **Equipment** ____ **Publication**

5. **Briefly describe the preferred procedure:** Two basic clinical techniques are described to decrease the ris of mercury vapor exposure to the patient during mercury amalgam removal: A) With a Rubber Dam B) Without a Rubber Dam

6. **Technique of preferred procedure:**
   - A) With a Rubber Dam
     1) Place rubber dam in the usual way
     2) Provide alternative source of air (Oxygen, Nitrous oxide, Room air)
     3) Place saliva ejector under dam to remove mercury vapor that penetrates latex
        IAOMT Data: 0-20 mcg/m^3
     4) Use high volume evacuation with isolate attachment (enhance with 2 evacuation pumps and/or auxiliary evacuation)
        IAOMT Data:
     5) Use copious amount of water in spray
     6) Section amalgams and remove in as large pieces as possible
     7) Remove and dispose of rubber dam immediately after amalgam removal
     8) Rinse and evacuate mouth immediately after removal of dam (use mercury vapor analyzer to guide length and thoroughness of oral cleansing)
     9) Rinse all instruments of mercury vapor used during removal (mirror, handpieces, etc.)

10) Immediately change patients protective wear and clean their face
11) Consider appropriate nutritional support before, during and after removal
12) Install room air purifiers or ionizers for everyone's well being

B) Without a Rubber Dam

1) Provide alternative source of air (Oxygen, Nitrous oxide, Room air)
2) Use high volume evacuation with isolate attachment (enhance with 2 evacuation pumps and/or auxiliary evacuation)
3) Use copious amounts of water in spray
4) Section amalgams and remove in as large pieces as possible
   IAOMT data: 4 quadrants amalgam removal, one at a time, 3 fillings/quad, without rubber dam, with HVE & Isolate attachment. In mcg/m^3 (Allen 9/8/92)

High Vol Evac	= 0
Stop HVE	= 10-50
10 second rinse	= 5-30
30 second rinse	= 0-15
50 second rinse	= 0

5) Rinse and evacuate mouth immediately after amalgam removal to remove vapor and chunks of amalgam (use mercury vapor analyzer to guide length and thoroughness oral cleansing)
6) Immediately change patients protective wear and clean their face
7) Consider appropriate nutritional support before, during and after removal
8) Install room air purifiers or ionizers for everyone's well being

7. Manufacturer(s):

1) Ionizer: American Environmental Systems, Colorado Springs, Co., (303) 530-7077
2) Jerome 411 Mercury Vapor Analyzer

8. Scientific Literature: Ochoa,1983; Gronka,1970; Roydhous,1985; Mantyla, 1976; Gordon, 1978; Schulein, 1984

9. Legal Aspects: 1990 USEPA Chronic Inhalation Concentration for Mercury: 0.3 micrograms / cubic mete of air

10. Historical Background: Common sense from scientific literature on mercury vapor and IAOMT data

AGPTHYG.1

IAOMT
Standards of Care

Preferred Procedure

Reducing Mercury Vapor Exposure for Doctor & Staff During Amalgam Removal

Preferred Procedure Code	DRSTHYG.1
Received	9/4/92
Scientific Review	9/4/92
Standard of Care Review	9/6/92
IAOMT Board Review	9/27/92
Provisional Approval	
Approval	9/27/92
No Opinion	
No Approval	

Your Name: Phillip P. Sukel, D.D.S., F.I.A.O.M.T. **Home Phone:** (708) 837-1301

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City: Arlington Heights **State:** Il. **Zip:** 60004 **Country:** USA

Are you a member of IAOMT? _XX_ Yes ____ No **Non-member Application Fee: $25.00.**

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1. Name of preferred procedure: Reducing Mercury Vapor Exposure for Doctor and Staff During Amalgam Removal

2. Alternative name(s) of preferred procedure:

3. What is this preferred procedure related to? ____ Medicine _XX_ Dentistry

4. Is this preferred procedure a .....? ____ Product _XXX_ Procedure ____ Equipment ____ Publication

5. Briefly describe the preferred procedure: Various clinical techniques are described to decrease the risk o mercury vapor exposure to Doctor & Staff during mercury amalgam removal.

6. Technique of preferred procedure:

1) Use high volume evacuation with isolate attachment (enhance with 2 evacuation pumps and/or auxiliary evacuation)
2) Wear protective mask during removal (see below for mask manufacturers)
3) Use copious amounts of water in spray
4) Section amalgams and remove in as large pieces as possible

IAOMT data: 4 quadrants amalgam removal, one at a time, 3 fillings/quad, without rubber dam, with HVE & isolate attachment. In mcg/m^3 (Allen 9/8/92)

High Vol Evac	= 0
Stop HVE	= 10-50
10 second rinse	= 5-30
30 second rinse	= 0-15
50 second rinse	= 0

5) Rinse and evacuate mouth immediately after amalgam removal (use mercury vapor analyzer tc guide length and thoroughness of oral area cleansing)
6) Immediately remove Doctor's gloves and at least rinse hands, face, glasses, etc. thoroughly before proceeding .... then take off your mask
   IAOMT Data: Under gloves measurement, immediately after removal, HVE, without isolate attachment, without rubber dam, from 1 to 16 amalgams. 30-50 mcg/m^3 (1.[illegible]2)
7) Change and/or clean patients protective wear and clean their face
8) Rinse mercury vapor from instruments exposed to mercury vapor (mirrors, han[illegible]pieces, etc.)
9) Consider appropriate nutritional support for Doctor & Staff before, during and after removals
10) Install room air purifiers or ionizers for everyone's well being

7. Manufacturer(s):

1) Ionizer: American Environmental Systems, Colorado Springs, Co., (303) 530-7077
2) 3M Mask: Special industrial mercury vapor mask. When not using place inside down, do not p into plastic bag
3) MSA Respirator: Mercury Vapor Respirator by Mine Safety Appliances, Pittsburgh, Pa.
4) Jerome 411 Mercury Vapor Analyzer

8. Scientific Literature: Ochoa,1983; Gronka,1970; Roydhous,1985; Mantyla, 1976; Gordon, 1978; Schulein, 1984

9. Legal Aspects: 1990 USEPA Chronic Inhalation Concentration for Mercury: 0.3 micrograms / cubic met of air and OSHA Work Place Exposure Limits

10. Historical Background: Common sense from the scientific literature on mercury vapor and IAOMT data

DRSTHYG.1

IAOMT
Standards of Care

Preferred Procedure

Reducing Mercury Vapor Exposure During Hygiene Procedures

Preferred Procedure Code	MVEHYG.1
Received	9/15/91
Scientific Review	8/24/92
Standard of Care Review	8/24/92
IAOMT Board Review	9/27/92
Provisional Approval	
Approval	9/27/92
No Opinion	
No Approval	

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Are you a member of IAOMT? Yes **Non-member Application Fee $25.00.**

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1. **Name of preferred procedure:** Reducing Mercury Vapor Exposure During Hygiene Procedures

2. **Alternative name(s) of preferred procedure:**

3. **What is this preferred procedure related to?** ____ Medicine _xx_ Dentistry

4. **Is this preferred procedure a .....?** ____ Product _xxx_ Procedure ____ Equipment ____ Publicatio

5. **Briefly describe the preferred procedure:** Various clinical methods are described to decrease the risk of mercury vapor exposure from mercury dental amalgams during various hygiene procedures.

6. **Technique of preferred procedure:**
   1. Avoid touching amalgam fillings with a rubber prophy cup or prophy brush while polishing teeth.
      IAOMT Data:
   2. Avoid touching amalgam fillings with the ultrasonic scaler during scaling.
      IAOMT Data:
   3. Avoid direct spray of air/baking soda polishers onto amalgam surfaces.
      IAOMT Data:
   4. Avoid polishing (finishing) amalgam fillings unless absolutely necessary such as proximal surfac when preparing adjacent tooth for a crown. If you must polish use lots of water spray and high volume evacuation and any other room air precautions.
      IAOMT Data: during polishing interproximals with 3M disks
      without water spray and high volume evacuation – 500-900 mcg/m^3
      with water spray and high volume evacuation – 15-40 mcg/m^3
      upon stopping and after rinsing for 30 seconds – 0-5 mcg/m^3
      So rinse mouth thoroughly when finished with HVE.
   5. Use alternative source of air (O_2 or mask with room air) for patient for any procedure that may generate mercury vapors from existing dental amalgams.
   6. Use high volume evacuation and saliva ejector during procedures (patient may hold HVE near mouth and/or auxiliary evacuation system).
   7. Doctor/Hygienist/Staff should wear protective mask (see below) to minimize inhalation of mercur vapors.
   8. Patient should wear appropriate protection.

7. **Manufacturer(s):**
    1. 3M - Special industrial mercury vapor mask. When not using place inside down, do not put in plastic bag
    2. MSA - Mercury Vapor Respirator by Mine Safety Appliances, Pittsburgh, Pa.
    3. Jerome 411 Mercury Vapor Analyzer

8. **Scientific Literature:** Ochoa, 1983; Gronka, 1970; Roydhous, 1985; Mantyla, 1976; Gordon, 1978; Schulein, 1984; Skinner, Science of Dental Materials.

9. **Legal Aspects:** 1990 USEPA Chronic Inhalation Concentration: 0.3 micrograms / cubic meter of air

10. **Historical Background:** Common sense from the scientific literature on mercury vapor and IAOMT dat

MVEHYG.1

Eur J Pediatr (1994) 153:607–610

ORIGINAL PAPER

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Mercury burden of human fetal and infant tissues

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Abstract The total mercury concentrations in the liver (Hg-L), the kidney cortex (Hg-K) and the cerebral cortex (Hg-C) of 108 children aged 1 day–5 years, and the Hg-K and Hg-L of 46 fetuses were determined. As far as possible, the mothers were interviewed and their dental status was recorded. The results were compared to mercury concentrations in the tissues of adults from the same geographical area. The Hg-K ($n = 38$) and Hg-L ($n = 40$) of fetuses and Hg-K ($n = 35$) and Hg-C ($n = 35$) of older infants (11–50 weeks of life) correlated significantly with the number of dental amalgam fillings of the mother. The toxicological relevance of the unexpected high Hg-K of older infants from mothers with higher numbers of dental amalgam fillings is discussed.

Conclusion Future discussion on the pros and cons of dental amlagam should not be limited to adults or children with their own amalgam fillings, but also include fetal exposure. The unrestricted application of amalgam for dental restorations in women before and during the childbearing age should be reconsidered.

Key words Mercury · Fetuses
Newborns · Infants · Dental amalgam

Abbreviations *Hg-C* total mercury concentration in the cerebral cortex (ng/g wet weight) · *Hg-K* total mercury concentration in the renal cortex (ng/g wet weight) · *Hg-L* total mercury concentration in the liver (ng/g wet weight)

Introduction

Recent investigations [1, 5] have shown in humans that dental amalgam fillings are the principal source of the mercury burden of adults, at least in geographic areas with a moderate consumption of fish and seafood. There is now widespread international focus on the pathophysiological significance of mercury that is continuously released from amalgam tooth fillings [6]. A result of one of these studies [5] was that some of the few infants investigated at that time showed relatively high mercury concentrations in their kidneys. To expand upon this finding, the objective of the present study was to determine the mercury concentration in tissues from a much larger population of infants and also from older children and fetuses. As far as possible the mothers were interviewed and their dental status determined.

Materials and methods

Liver and kidney specimens from 46 fetuses and liver, renal cortex and cerebral cortex from 108 children aged 1 day–5 years were collected during 1990–1992 from autopsies performed at the Pathological Institute and the Institute of Forensic Medicine of the University of Munich.

Abortions had mainly been induced for medical reasons. All infants had died suddenly and most were diagnosed as sudden infant death syndrome.

From 40 mothers of fetuses and 65 mothers of children, information on occupational, domestic or medical mercury burden were

available and the dental status of these mothers was recorded. In no case was an occupational exposure to mercury of the parents or an extreme fish consumption of the mother or the child reported. There was no case of an unusual mercury burden of the child (e.g. by a broken thermometer or the application of mercury containing pharmaceuticals).

Tissue samples of approximately 1 g were digested with 2 ml nitric acid (min. 65%, Supra pure grade, E. Merck, Darmstadt, FRG) for 6 h at 140°C in sealed Teflon lined pressure vessels (Parr Acid Digestion Bomb, H. Kürner, Rosenheim, FRG). After cooling the solutions were diluted with water to 10 ml and the concentrations of total mercury were determined by cold-vapour atomic absorption spectrometry after enrichment on a gold-platinum-net [19]. The accuracy of the method was established by standard reference materials (BCR reference material # 145, bovine liver and IAEA fish homogenate MA-A-2).

Total mercury concentrations were calculated as ng mercury per g tissue wet weight. Because the distribution of the values was nonparametric, medians were calculated. Subgroups were compared by the Mann-Whitney test. Correlations were determined by Spearman rank correlation.

In order to combine the results of fetuses and children into a single figure, the gestational age of the fetuses was converted to "negative weeks of life", i.e. 40 weeks minus gestation.

The group under investigation was classified in 4 subgroups according to the age:

1. Fetuses: from gestation until birth
2. Newborns and young infants: 0–10 weeks
3. Older infants: 11–50 weeks
4. Young children: 1–5 years

Table 1 Spearman rank correlation of the mercury concentrations in human tissues to the number of teeth with amalgam fillings of the mother

		Fetuses	Newborns and younger infants (0–10 weeks)	Older infants (11–50 weeks)	Younger children (1–5 years)
Liver	*n*	40	19	35	11
	r	+0.366	±0.000	+0.254	−0.163
	sig.	b	a	a	a
Renal cortex	*n*	38	19	35	11
	r	+0.537	+0.212	+0.454	+0.273
	sig.	d	a	c	a
Cerebral cortex	*n*	0	18	35	11
	r		+0.213	+0.372	−0.181
	sig.		a	b	a

Significance: a = < 95%; b = > 95%; c = > 99%; d = > 99.9%

Table 2 Comparison (Mann-Whitney-Test) of the mercury concentrations (ng Hg/g, medians) in tissues of human fetuses and older infants (age: 11–50 weeks) from mothers with either 0–2 or 10 or more teeth with amalgam fillings to age-matched adults (age: 16–45 years) with the same number of amalgam fillings as the mothers [5, 19]

		0–2 Teeth with amalgam	>10 Teeth with amalgam	Significan of differer
Liver	Fetuses	12.68 (n = 10)	25.85 (n = 14)	b
	Older infants	19.2 (n = 10)	34.4 (n = 8)	b
	Younger adults	18.7 (n = 41)	67.2 (n = 19)	d
Renal cortex	Fetuses	5.95 (n = 10)	10.3 (n = 11)	d
	Older infants	20.75 (n = 10)	115.6 (n = 8)	c
	Younger adults	47.3 (n = 41)	409.25 (n = 18)	d
Cerebral cortex	Older infants	2.05 (n = 10)	3.95 (n = 8)	a
	Younger adults	14.7 (n = 39)	25.7 (n = 19)	b

Significance: a = < 95%; b = > 95%; c = > 99%; d = > 99.9%

All results were compared parallel to those of 34 adults in th age range as the mothers (16–45 years) having at least tw with dental amalgam [5, 19].

Results

Statistical correlations between the mercury concent in various organs and the number of maternal teeth dental amalgam fillings are shown in Table 1.

In fetuses the mercury concentration in the liver L) was significantly correlated with the number of r nal teeth with amalgam fillings. No such correlatio found for Hg-L in the other age groups.

The mercury concentration in the renal cortex (H and maternal teeth with amalgam fillings were si cantly correlated in fetuses and older infants but not other age groups.

The mercury concentration in the cerebral cortex C) was significantly correlated with the number of n nal teeth with amalgam fillings in older infants only.

In fetuses and older infants significantly higher mercury concentrations in the liver and the renal c were found, if the mothers had ten or more teeth with tal amalgam in comparison to fetuses or older in from mothers with a maximum of two teeth with ama fillings (Table 2). Figures 1–3 illustrate the range of vidual mercury concentrations in liver, kidney cortex cerebral cortex, respectively, of all fetuses and child compared to the range of adults without dental amalg Many older infants have rapidly acquired a tissue bu of mercury in the kidney that is equivalent to or which ceeds the range of mercury in adults who do not h amalgam fillings.

Discussion

The mercury concentration in different tissues of fetu and infants has been rarely studied and has never been lated to maternal amalgam fillings. Suzuki et al. [20] ported the mercury concentrations in five brain and f liver specimens of fetuses and Markesbery et al. [14] two fetal, one term and three infant brains. Their rest lie within the same range of concentrations that we fou

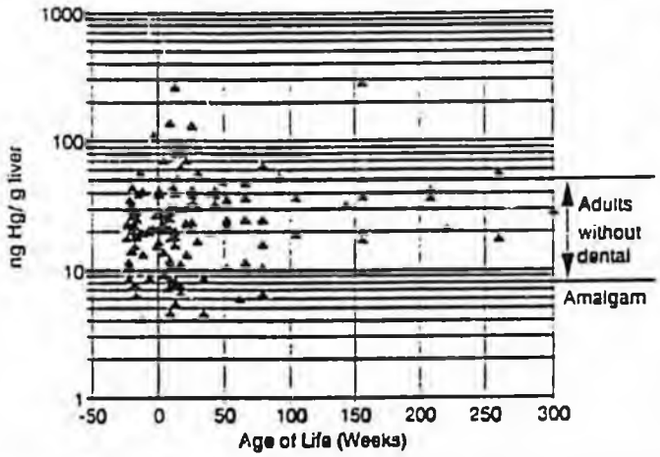

Fig. 1 Total mercury concentration in the liver of human fetuses and infants related to age of life

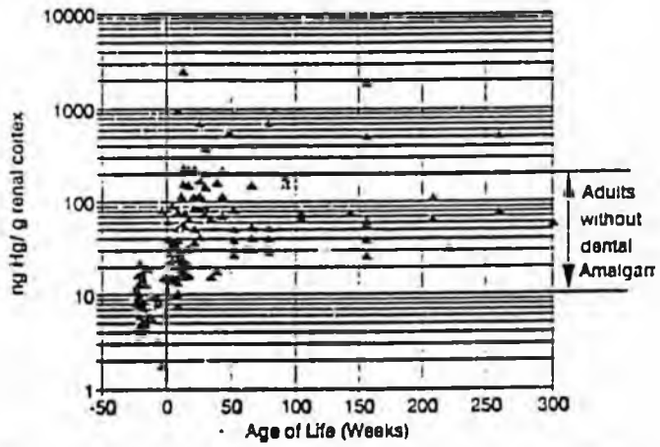

Fig. 2 Total mercury concentration in the renal cortex of human fetuses and infants related to age of life

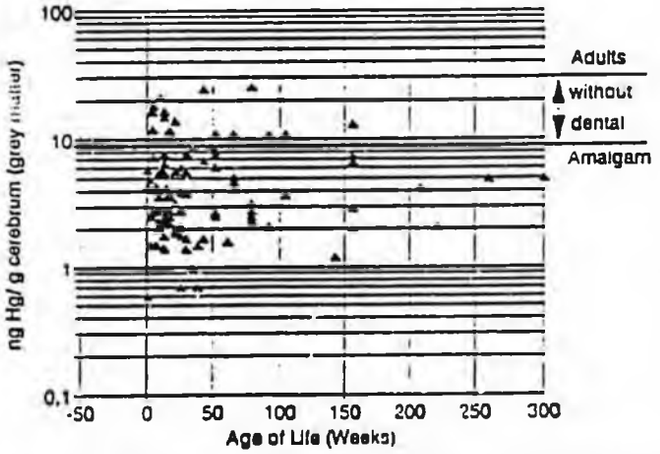

Fig. 3 Total mercury concentration in the cerebral cortex of human infants related to age of life

Data from earlier investigations [15, 16] are less reliable due to the limitations of analytical methods at that time.

Exposure of pregnant guinea pigs to mercury vapour [25, 26] or pregnant ewes to amalgam fillings (containing radioactive ^{203}Hg) [22] resulted in an increase of the mercury concentrations of the fetuses and the newborn. The placental transfer of mercury from the mother to the fetus depends on the maternal mercury burden [7, 10, 12, 21]. Since the number of dental amalgam fillings is significantly related to the mercury concentration in the maternal tissues of animals [22] and humans [5] the number of maternal amalgam fillings should also influence the mercury concentration in human fetal tissues. We were able to confirm this relationship with respect to the fetal liver and kidney. The avidity of maternal kidneys for mercury documented in Table 2 can be explained by the storage function of the maternal kidney for mercury. It can be assumed that the "mobile" mercury, available for a transfer through the placenta, derives predominantly from the maternal liver (and comparable compartments) and not from the maternal kidney. Moreover, the fetal liver seems to trap the transferred mercury to some extent [8, 12, 25, 26] and thus prevents a higher accumulation in the fetal kidney. The present findings in humans compare favourably with similar results reported earlier in sheep [22].

The mercury concentrations in the tissues of newborns and young infants were not well correlated with the number of maternal teeth with amalgam fillings. This may be explained by a superposition of the initial influence of the maternal dental amalgam on the mercury concentration in the infant tissues during pregnancy by a redistribution of mercury from the infant liver to the infant kidney and other tissues in the first months of life and a simultaneous new intake of mercury in this transient period of life [12, 26].

Maternal amalgam fillings appears to influence the Hg-C in older infants approximately as much as they influence Hg-C in adults. The influence on the Hg-K in older infants is approximately half so great as that of own fillings of adults (see Table 2).

Most of the babies under investigation were not nursed or nursed only for a few weeks. Hence it follows that the higher Hg-K and Hg-C of offspring from mothers with amalgam fillings is due at least partly to an exposure derived in utero and not from breastmilk. If and to what extent nursing by mothers with multiple amalgam fillings contributes to the mercury burden of the baby should be further investigated. Dental amalgam mercury does concentrate in sheep milk [22], however, Klemann et al. [9] found no statistically significant correlation between the mercury concentration in human breastmilk and the number of amalgam fillings of the mothers.

At the present time, the toxicity of mercury vapour from dental amalgams is being assessed through a variety of investigations [1]; however, the toxicological consequence of the relatively high mercury concentrations in the renal cortex of infants, as found in the present study, has not been determined. In contrast to the well-known vulnerability of the developing brain to an exposure to mercury vapour (most of the mercury from dental amalgam is released in this form) or methyl-mercury, there are

no reports that the infant kidney is more sensitive to inorganic mercury than the adult kidney [6, 10, 11, 13, 21, 23, 24, 27]. On the other hand, current evidence suggests that the nephrotic syndrome following absorption of mercury compounds results from an immunotoxic response [24]. Amalgam mercury has also been shown to alter several indices of kidney function in sheep [2]. Possible differences in the binding form of the mercury in the kidney of fetuses, infants and adults, e.g. to metallothionein or selenium, are presently not known [4, 17, 18].

The present findings clearly demonstrate that further discussion on the pros and cons of dental amalgam should not be focused exclusively on adults or children with their own amalgam fillings [3, 27], but also on the offspring.

From our results it can be concluded that infants can accumulate mercury, apparently derived from maternal amalgam fillings, in their kidneys to a similar extent as older children or adults do from their own fillings. Therefore the unrestricted application of amalgam for dental restorations in women before and during the child-bearing age should be reconsidered in analogy to the recommendation of the German Health Authorities from 1992 [3], which argued that because of a higher vulnerability of infants to mercury, amalgam cannot be further recommended for dental restorations for children up to 6 years and notably not during the first 3 years of life. At the very least, high numbers of amalgam fillings should be avoided for women before and during child-bearing age. In 1991, the WHO confirmed an earlier statement from 1980: "The exposure of women of child-bearing age to mercury vapour should be as low as possible" [24].

Acknowledgements The authors wish to acknowledge the financial support of this investigation by the Degussa AG, Frankfurt/Main and the generous assistance in the collecting of the fetal samples by the I. Gynaecological Clinic and the Institute of Pathology of the Ludwig-Maximilians-University, Munich.

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Maternal-fetal distribution of mercury (^{203}Hg) released from dental amalgam fillings

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VIMY, M. J., Y. TAKAHASHI, AND F. L. LORSCHEIDER. *Maternal-fetal distribution of mercury (^{203}Hg) released from dental amalgam fillings.* Am. J. Physiol. 258 (Regulatory Integrative Comp. Physiol. 27): R939–R945, 1990.—In humans, the continuous release of Hg vapor from dental amalgam tooth restorations is markedly increased for prolonged periods after chewing. The present study establishes a time-course distribution for amalgam Hg in body tissues of adult and fetal sheep. Under general anesthesia, five pregnant ewes had twelve occlusal amalgam fillings containing radioactive ^{203}Hg placed in teeth at 112 days gestation. Blood, amniotic fluid, feces, and urine specimens were collected at 1- to 3-day intervals for 16 days. From *days 16–140* after amalgam placement (16–41 days for fetal lambs), tissue specimens were analyzed for radioactivity, and total Hg concentrations were calculated. Results demonstrate that Hg from dental amalgam will appear in maternal and fetal blood and amniotic fluid within 2 days after placement of amalgam tooth restorations. Excretion of some of this Hg will also commence within 2 days. All tissues examined displayed Hg accumulation. Highest concentrations of Hg from amalgam in the adult occurred in kidney and liver, whereas in the fetus the highest amalgam Hg concentrations appeared in liver and pituitary gland. The placenta progressively concentrated Hg as gestation advanced to term, and milk concentration of amalgam Hg postpartum provides a potential source of Hg exposure to the newborn. It is concluded that accumulation of amalgam Hg progresses in maternal and fetal tissues to a steady state with advancing gestation and is maintained. Dental amalgam usage as a tooth restorative material in pregnant women and children should be reconsidered.

mercury vapor; mercury exposure; fetal mercury exposure; tooth fillings

IT IS WELL established in humans that the continuous release of Hg vapor from in situ dental amalgam, "silver" tooth restorations, is markedly increased for prolonged periods after chewing or tooth brushing (13, 15, 17, 18). The weight composition of these Hg-silver tooth fillings is typically 50% elemental Hg metal (14), and the levels of Hg vapor in the mouth are correlated with the number of such fillings (17, 18).

A very recent study in sheep has demonstrated by whole body image scan that radioactive Hg vapor released from dental amalgam fillings is initially absorbed at lung, gastrointestinal, and jaw tissue sites (6). However, the pattern of tissue distribution of such Hg over time remains unknown. Therefore, the primary objective of the present study was to establish a time-course distribution for amalgam Hg in body tissues of adult sheep.

Although it has long been known that Hg from sources other than dental amalgam can cross the placental barrier and be taken up by the fetus (2, 3), no evidence exists that fetal exposure to Hg will occur because of the presence of dental amalgam in the mother. Therefore, another objective of this investigation was to determine the extent to which dental amalgam Hg will accumulate in fetal tissues during the latter one-third of pregnancy.

METHODS

Five adult ewes (Dorset/Suffolk cross) of 3–5 yr of age, with an average body weight of 68.4 ± 7 kg were bred, and the day of mating was considered to be *day 0* of gestation. At ~112 days gestation ewes were prepared for fetal and dental surgery. Halothane general anesthesia was administered through an endotracheal tube fitted to a Narkovet-2 gas anesthetic machine, and the maternal jugular vein, fetal femoral and jugular veins, and the amniotic sac were cannulated with Tygon catheters that were treated with 7% tridodecylmethylammonium chloride (TDMAC) heparin complex solution (Polysciences, Warrington, PA). Catheters were exteriorized using procedures that we have previously employed in sheep (8). These chronic indwelling catheters permitted serial sample collection throughout the course of gestation. Ewes were placed in individual metabolic cages 48 h after surgery so that fecal and urine specimens could be monitored intermittently over 2 wk for Hg excretion. Fetal venous blood gases were monitored for pH, P_{CO_2}, and P_{O_2} at 2-day intervals after surgery to confirm viability and health of the fetus (Instrumentation Laboratory System, Lexington, MA, model 1301 pH blood gas analyzer). All animals were provided with water ad libitum and fed fresh hay twice daily throughout the course of the experiments.

At the time of fetal lamb surgery 12 radioactive occlusal amalgam fillings were placed in teeth of the ewe (three molars in each quadrant of the mouth). Dental procedures were as employed previously (6), and each trimmed and finished filling had a total alloy mass of ~850 mg of which 50% was pure elemental Hg. Before amalgam mixing, ^{203}Hg, which had a specific activity of 13 mCi/g (New England Nuclear, Boston, MA), was diluted 11-fold with nonradioactive elemental Hg. Each ewe received a total of ~7 mCi ^{203}Hg. After amalgam placement and trimming of the tooth fillings the oral

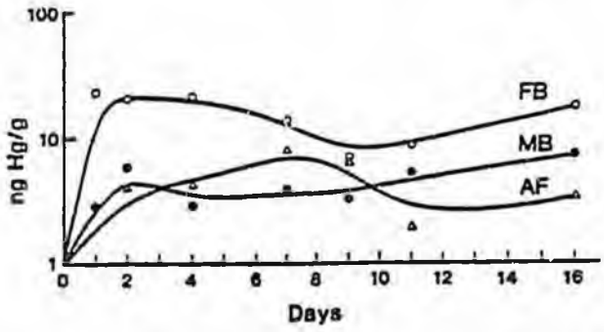

FIG. 1. Average concentration of Hg from dental amalgam in maternal blood (MB), fetal blood (FB), and amniotic fluid (AF) for 16 days after amalgam placement. Each point represents mean of 5 animals.

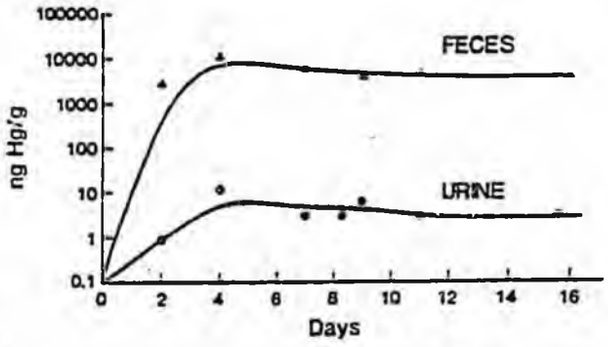

FIG. 2. Average concentration of Hg from dental amalgam excreted in maternal urine and feces for 16 days after amalgam placement. Each point represents mean of 5 pregnant animals.

cavity was flushed thoroughly with water and aspirated several times to remove amalgam particles.

Blood, amniotic fluid, feces, and urine specimens were collected at 1- to 3-day intervals, and the corresponding 24-h fecal mass and urine volume were recorded. Intraoral air Hg vapor was monitored intermittently in the ewe by procedures described previously (17). Animals were euthanized with pentobarbital sodium-saturated KCl on *days 16, 29, 73, 100,* and *140* (*days 16, 23, 25, 34,* and *41* for fetal lambs) after dental surgery, and tissue specimens were taken from a variety of maternal and fetal organs and weighed. Gastrointestinal tract samples were washed in isotonic saline to remove gut contents from the tissue specimens. Plasma was obtained by centrifugation, and separated red cells were washed with two volumes of saline. Total blood volume in the ewe was estimated to average 74 ml/kg (19). Within 48 h after parturition a 5-ml sample of milk was expressed from the breast of each ewe.

All tissue and fluid specimens were analyzed for radioactivity, and total Hg concentrations were calculated as previously described (6); corrections were made for isotopic decay ($t_{\frac{1}{2}}$ = 47 days) and isotope specific activity; the dilution factor for nonradioactive Hg was added before mixing the amalgam. The final calculation value represented the total Hg from dental amalgam per gram (wet wt) of tissue or fluid. Data were plotted with average values as a function of days after amalgam placement using a best-fit-curve method to graphically depict patterns of Hg distribution (Harvard Graphics version 2.1, Software Publishing, Mountain View, CA).

RESULTS

The average intraoral air Hg vapor level in the five ewes during the present experiments was 44 μg Hg/m^3 (range 13–98) from 12 new amalgam restorations, which compares with average vapor levels in 10 human subjects after chewing of 43–45 μg Hg/m^3 from 12 occlusal amalgam restorations of variable age (18).

Figure 1 shows the average concentration of Hg (ng/g) from dental amalgam in maternal blood, fetal blood, and amniotic fluid during a 16-day period after amalgam placement for five pregnant ewes and their fetuses. Amalgam Hg was evident in all three fluids within 48 h when it reached a peak concentration. Elevated Hg levels were maintained for the 2-wk duration of specimen collection at ~4 ng/g in maternal blood (range 3–7) and amniotic fluid (range 2–8) and at ~16 ng/g (range 7–23) in fetal blood.

Figure 2 shows the average concentration of Hg (ng/g) from dental amalgam excreted in maternal urine and feces during a 16-day period after amalgam placement in

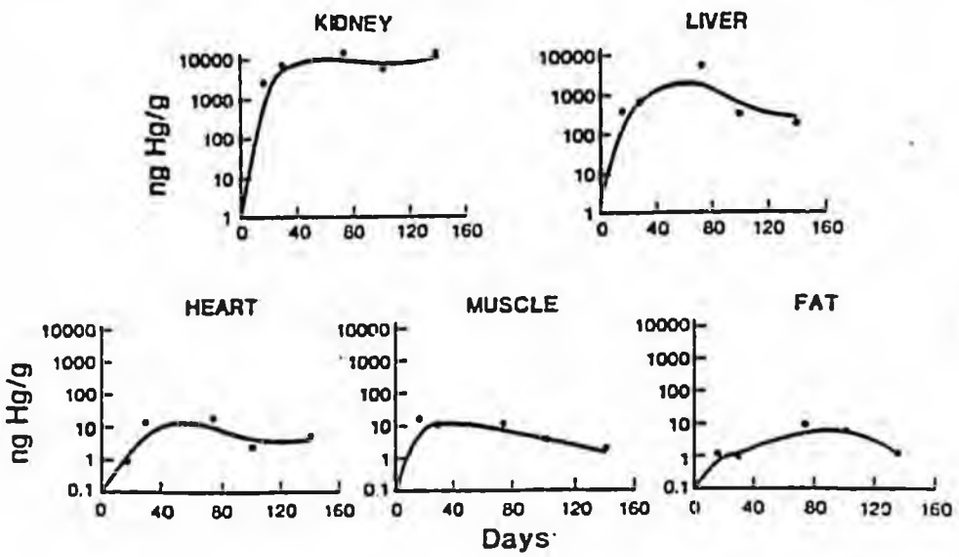

FIG. 3. Concentration of Hg from dental amalgam in kidney, liver, heart, muscle, and fat for each of 5 adult ewes autopsied at different times after amalgam placement.

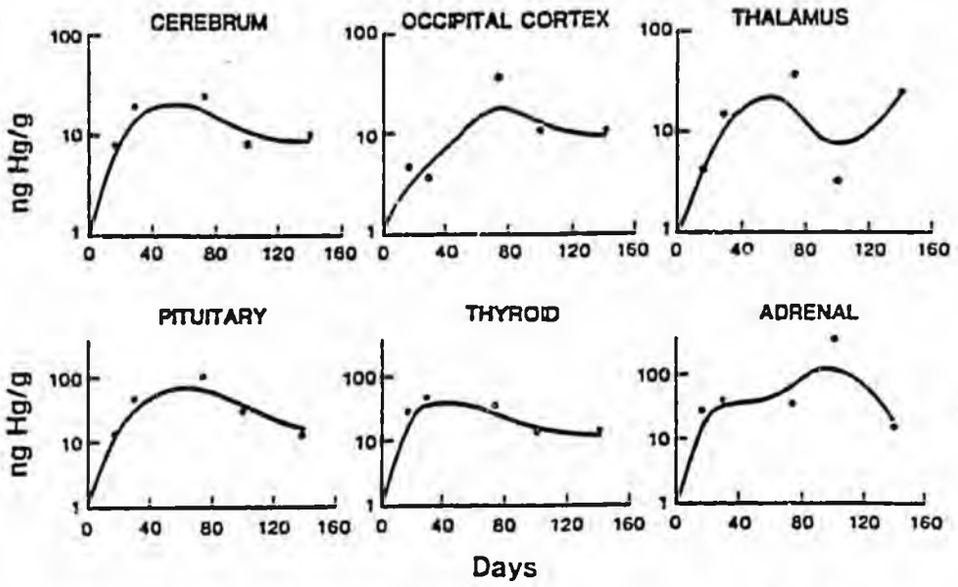

FIG. 4. Concentration of Hg from dental amalgam in brain cerebrum, occipital cortex, and thalamus and in pituitary, thyroid, and adrenal glands for each of 5 adult ewes autopsied at different times after amalgam placement.

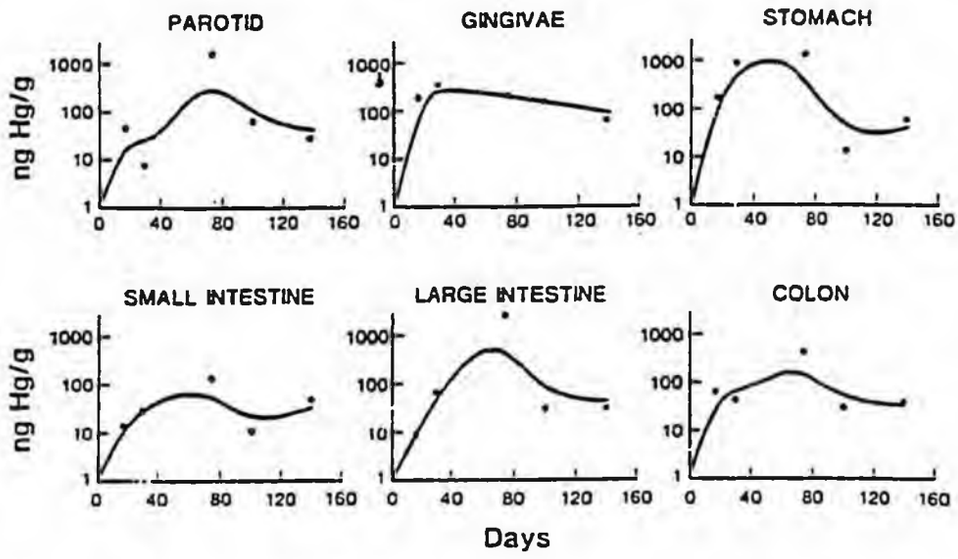

FIG. 5. Concentration of Hg from dental amalgam in oral and gastrointestinal tissues: parotid gland, gingivae, stomach, small intestine, large intestine, and colon for each of 5 adult ewes autopsied at different times after amalgam placement.

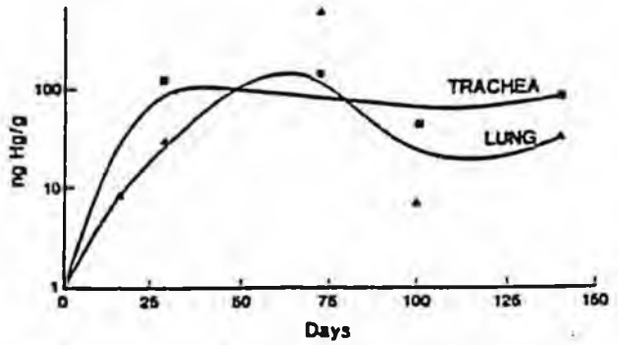

FIG. 6. Concentration of Hg from dental amalgam in lung and trachea for each of 5 adult ewes autopsied at different times after amalgam placement.

five pregnant ewes. Urinary levels rose rapidly and after *day 4* tended to plateau. The average urine value for this period was 5 ng/g (range 1–12) which, based on an average 24-h urine volume of 840 ml, would mean that as much as 10 μg Hg from amalgam was eliminated daily by the renal route. In contrast, the initial fecal Hg concentrations averaged 3,800 ng/g which, when corrected for an average fecal mass of 2,030 g/day, would mean that ~7.7 mg Hg from amalgam could be eliminated daily from the gastrointestinal tract during this 2-wk period. Thereafter, fecal Hg concentration measurements taken at time of autopsy showed a gradual decline such that by *day 73* after amalgam placement fecal Hg levels were less than one-half of the initial concentrations.

Figure 3 illustrates the concentration of Hg from dental amalgam in kidney, liver, heart (ventricle), gluteus muscle, and mesentery fat for each of five ewes autopsied at different times after amalgam placement. By 29 days, kidney Hg levels rose to ~9,000 ng Hg/g, and these levels were maintained throughout the 140-day duration of the study. A similar pattern of Hg concentration was observed in liver but with lower levels remaining at ~1,000 ng Hg/g until 140 days. This is in contrast to heart and muscle, which had Hg levels that plateaued at ~10 ng Hg/g, and fat, which had lower levels of Hg ranging from 1 to 5 ng/g.

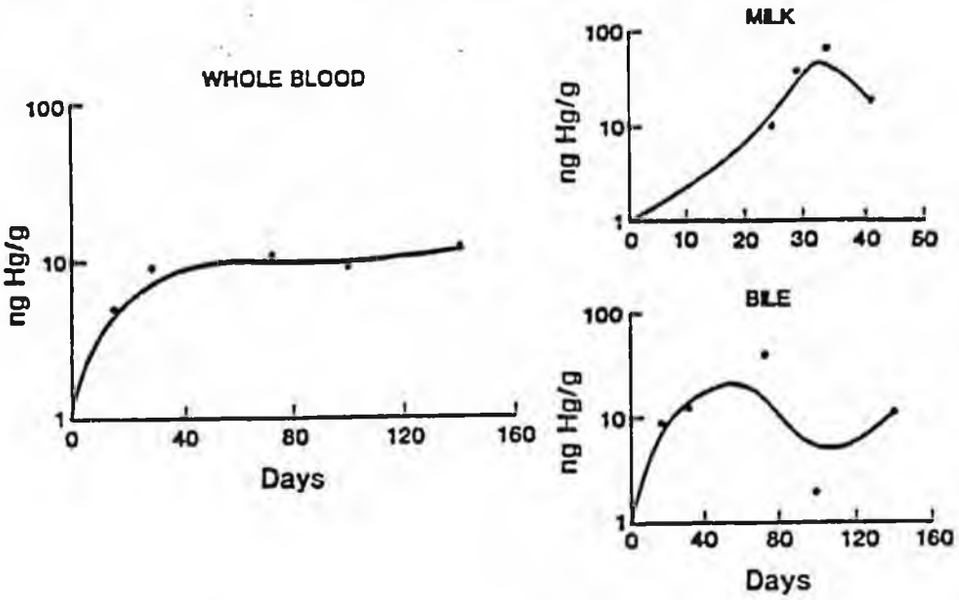

FIG. 7. Concentration of Hg from dental amalgam in whole blood, milk, and bile for each of 5 adult ewes autopsied at different times after amalgam placement.

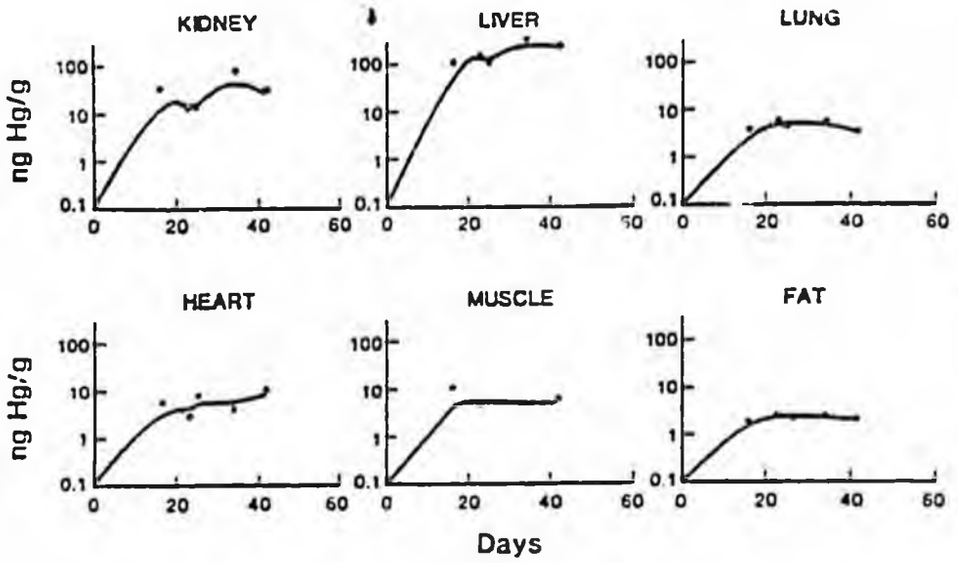

FIG. 8. Concentration of Hg from maternal dental amalgam in kidney, liver, lung, heart, muscle, and fat of 3–5 fetal lambs exposed in utero for various times after amalgam placement.

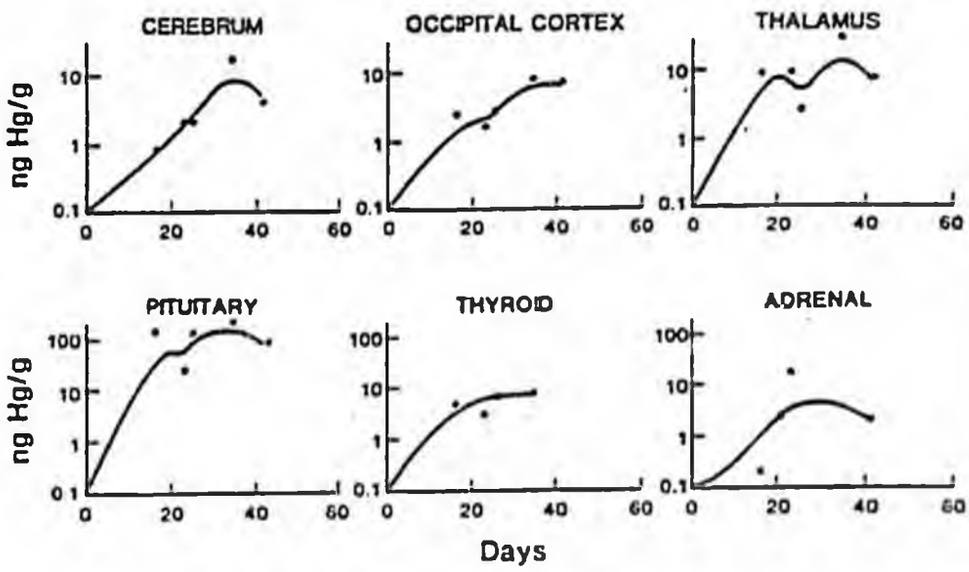

FIG. 9. Concentration of Hg from maternal dental amalgam in brain cerebrum, occipital cortex, and thalamus, and in pituitary, thyroid, and adrenal glands of 3–5 fetal lambs exposed in utero for various times after amalgam placement.

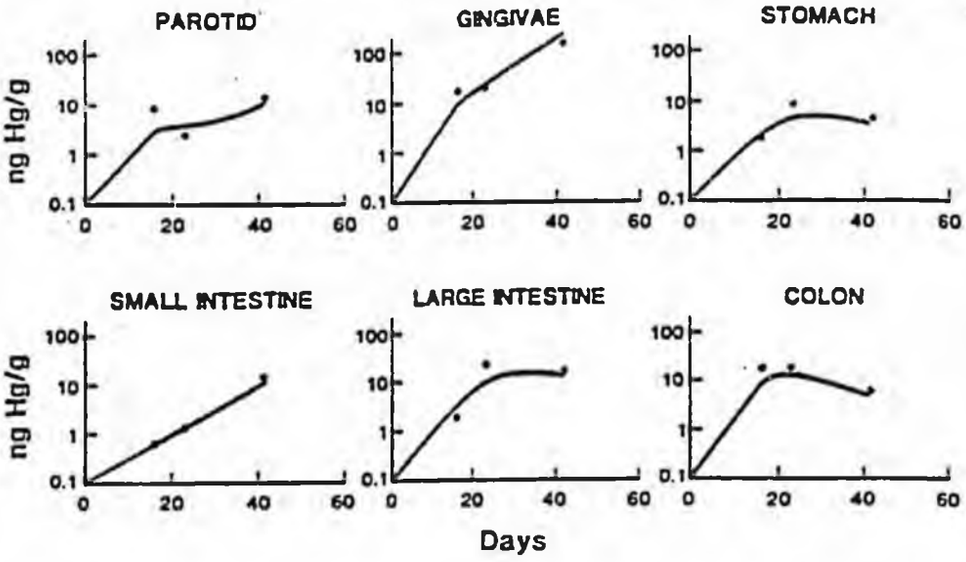

FIG. 10. Concentration of Hg from maternal dental amalgam in oral and gastrointestinal tissues: parotid gland, gingivae, stomach, small intestine, large intestine, and colon of 3–5 fetal lambs exposed in utero for various times after amalgam placement.

Figure 4 shows the concentration of Hg from dental amalgam in three regions of the brain and in three endocrine gland tissues in each of five ewes autopsied at different times after amalgam placement. Brain cerebrum, occipital lobe, and thalamus showed evidence of Hg concentration as early as 16 days, and from 29 to 140 days Hg levels ranged from 3 to 13 ng/g. After 29 days, pituitary, thyroid, and adrenal glands maintained somewhat higher Hg concentrations, ranging from ~10 to 100 ng/g.

Figure 5 depicts the concentration of Hg from dental amalgam in oral and gastrointestinal tissues from each of five ewes autopsied at different times after amalgam placement. Parotid gland had Hg levels ranging from 10 to 1,000 ng/g, whereas gingivae maintained a plateaued level of 200–300 ng Hg/g until 140 days. Stomach had Hg levels as high as 1,000 ng/g during the 140-day period, in contrast to small intestine, large intestine, and colon in which Hg levels ranged from ~10 to 200 ng/g.

Figure 6 shows the concentration of Hg from dental amalgam in respiratory tissues for each of five ewes autopsied at different times after amalgam placement. Lung had variable Hg levels ranging from 20 to 600 ng/g, and trachea cilial lining had Hg levels of between 50 and 120 ng/g throughout the 140-day period of the study.

Figure 7 illustrates that amalgam Hg levels in whole blood of five ewes averaged 10 ng/g and remained relatively constant during the 140-day period. Based on an average blood volume of 4,800 ml per ewe, this would mean that by 29 days after amalgam placement the total circulating pool of Hg in blood at any given time was at least 48 μg. Bile in these ewes at autopsy had levels of Hg that ranged from 3 to 40 ng/g during this same period. Milk obtained within 2 days after birth, at 25–41 days after amalgam placement, contained levels of Hg from dental amalgam that reached as high as 60 ng/g.

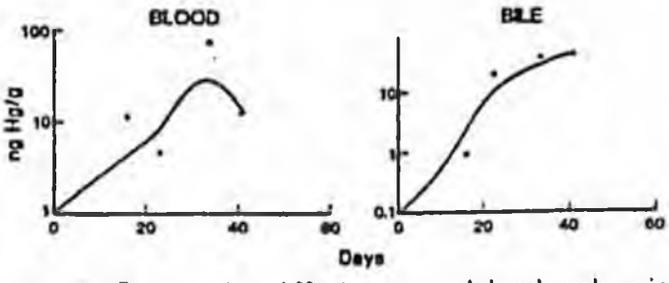

FIG. 11. Concentration of Hg from maternal dental amalgam in blood and bile of 3–5 fetal lambs exposed in utero for various times after amalgam placement.

Figure 8 demonstrates the concentration of amalgam Hg in kidney, liver, lung, heart, gluteus muscle, and mesentery fat of three to five fetal lambs exposed in utero to Hg from maternal dental amalgam for 16–41 days after amalgam placement. Fetal kidney had Hg levels of 10–14 ng/g in contrast to liver, which had higher levels of 100–130 ng Hg/g. Fetal lung, heart, and muscle had levels of Hg that were <10 ng/g, and fat had the lowest concentration at 1–2 ng Hg/g.

Figure 9 displays the concentration of amalgam Hg in regions of brain and in three endocrine glands of 3–5 fetal lambs exposed in utero to Hg from maternal dental amalgam for 16–41 days after amalgam placement. The highest Hg levels in cerebrum, occipital cortex, and thalamus were ~10 ng/g. This was in contrast to the fetal pituitary, which contained >100 ng Hg/g compared with thyroid and adrenal glands with <10 ng Hg/g.

Figure 10 shows the concentration of amalgam Hg in oral and gastrointestinal tissues of 3–5 fetal lambs exposed in utero to Hg from maternal dental amalgam for 16–41 days after amalgam placement. Fetal parotid gland had Hg levels that did not exceed 10 ng/g compared with levels in gingivae of 10–120 ng/g. Stomach, small intestine, large intestine, and colon had Hg levels of 10 ng/g or less.

Figure 11 demonstrates amalgam Hg concentration in blood and bile of 3–5 fetal lambs exposed in utero to Hg from maternal dental amalgam for 16–41 days after amalgam placement. Fetal blood Hg levels were variable and ranged from 3 to 75 ng/g, whereas bile Hg levels ranged from 1 to 47 ng/g.

Other data obtained in these experiments revealed that placental cotyledon concentration of amalgam Hg was 24, 161, and 289 ng/g after 16, 25, and 34 days, respec-

tively, of in utero exposure to maternal dental amalgam. The red blood cell-to-plasma ratio of amalgam Hg in the ewes from 16 to 140 days was 0.44 and in the fetal lambs was 0.97 after 16 to 41 days in utero exposure. Cerebrospinal fluid concentrations of amalgam Hg in the ewes averaged 4.6 ng/g and in the fetuses 5.1 ng/g.

DISCUSSION

The results of these experiments demonstrate that Hg from dental amalgam will appear in maternal and fetal blood and amniotic fluid within 2 days after placement of amalgam tooth restorations in the mother. Excretion of some of this Hg will also commence within 2 days through fecal and urinary elimination. Highest concentrations of Hg from amalgam in the adult occur in kidney and liver with substantial levels also present in endocrine glands, oral tissues, stomach, and the respiratory tract. In the fetus the highest amalgam Hg concentrations appear in liver and pituitary gland during the latter one-third of pregnancy when the placenta also progressively concentrates Hg as gestation advances to term. Finally, milk concentration of amalgam Hg postpartum can provide a potential source of Hg exposure to the newborn.

In the present study the average intraoral Hg vapor level released from 12 dental amalgam fillings in sheep was nearly identical to average vapor measurement levels obtained in humans with the same number of occlusal amalgam restorations (18). Justification for using the sheep as an experimental model to study the metabolism of dental amalgam Hg has been detailed in an earlier report (6). Although in vivo radioisotope experiments of this nature are perhaps more difficult to perform because of animal containment requirements than nonisotopic studies employing mass spectroscopy, neutron activation analysis, or autometallography analyses of Hg, our design has the distinct advantage that all of the Hg measured originates only from dental amalgam and cannot be attributed to food, water, or background environmental sources. Extension of these studies beyond 140 days would be limited by the physical half-life for ^{203}Hg of 47 days. All amalgam restorations remained intact during the 140-day duration of this study.

The general pattern of tissue concentration of Hg from dental amalgam reveals that, in the early phase from 16 to 29 days, a progressive increase in Hg uptake is at least partially dependent on the length of time elapsed after amalgam placement. After 29 days, concentration levels tended to remain in a plateau pattern suggesting that at least for the first 140 days after amalgam placement, tissue uptake of Hg will replace tissue turnover at a relatively constant steady-state rate.

The total circulating pool of amalgam Hg in blood was substantially higher than most tissue levels at any given time during the course of the experiment, implying that tissues have ready access to a regenerating Hg supply as it is continuously released from dental amalgam fillings. In this study the red blood cell-to-plasma ratios of Hg from amalgam in both the ewe and fetal lamb were less than one. This indicates that most of the amalgam Hg that is absorbed by several previously illustrated routes into sheep tissues (6) has remained in the elemental or inorganic form, since methyl Hg will preferentially accumulate in red blood cells with a resultant RBC-to-plasma ratio of 9:1 (1).

The large amount of amalgam Hg excreted daily in the feces may be caused by swallowing Hg with saliva or food and its subsequent concentration by the colon, and also by biliary concentration of blood Hg and secretion of Hg into the gut. It has been demonstrated in rats that inorganic Hg complexed to protein in bile is not readily reabsorbed and therefore is mostly excreted (10). Although by 140 days after amalgam placement we estimate as much as 13% of the amalgam Hg might be lost through the fecal route, the rate of loss rapidly declines. We would expect that the Hg loss would be much less than this amount over the next 140-day period if the present study had been extended. The placement and condensation of amalgam results in a tooth restoration that initially has a higher Hg concentration in the superficial biting surface area. Thus chewing forces on the new restorations would be expected to release greater amounts of elemental Hg vapor and amalgam microparticles containing proportionately higher amounts of Hg during the initial 2-wk phase.

The maternal tissue data suggest that chewing stimulation of the dental amalgams resulted in the release of Hg vapor, some of which was inhaled. Since ~80% of inhaled Hg vapor is absorbed across the lung and retained (9), this would explain the elevation in maternal blood levels of Hg and the resultant high concentration of amalgam Hg in maternal kidney and liver. Both kidney and liver were shown to be major sites of Hg deposition when human subjects inhaled radioactive Hg vapor from a nonamalgam source, and kidney and brain are considered to be critical target organs for Hg vapor effects (7). The data also suggest that some amalgam Hg may be absorbed across the lining of the maternal gastrointestinal tract, since Hg was found in high amounts in both the mucosal lining and contents of the tract. This Hg could have entered the tract as vapor swallowed with food and dissolved in saliva or as microparticles of amalgam and mercuric ions from the chewing and grinding action of the teeth. Although ~10% of Hg in the inorganic form (divalent and monovalent Hg) is absorbed across the gastrointestinal tract (16), the large amount of amalgam Hg present in the tract may, nevertheless, present a substantial challenge to the mother. Fetal colon concentration of amalgam Hg may indicate that meconium is the vehicle for transferring Hg to amniotic fluid.

In the adult ewe the high levels of Hg from amalgam that are concentrated in kidney are approximately ninefold greater than Hg levels found in adult liver. This is in marked contrast to the fetal lamb in which kidney concentration of Hg was ~0.1 times that of the liver. This may simply reflect the functional status of the adult kidney, whereas in the fetus the liver serves as a functional erythropoietic organ. Fetal liver erythropoiesis may also explain why Hg levels in fetal blood tended to be higher than levels in adult blood. Also, high Hg levels in fetal liver may be a consequence of most umbilical vein blood first passing directly to the fetal hepatic circulation. Sheep adult kidney levels of Hg from amal-

gam observed in this study are higher than levels reported in human kidney (12). However, our results were observed for only 140 days from 12 new amalgam fillings all placed in the mouth at the same time. This is in contrast to human data obtained in subjects in whom levels of Hg may have declined somewhat over an 8 to 10-yr duration from a variable number of amalgams of unknown age (12).

Maternal brain levels of Hg released from amalgam in this study were 3–13 ng Hg/g during a relatively brief duration of 16–140 days after amalgam placement. This agrees with net Hg levels found in autopsy specimens of human brain cortex of 7.2 ng/g from subjects with dental amalgams (4, 12), after subtraction of brain Hg levels in control (nonamalgam) subjects of 5.7 ng/g.

It is interesting to note that adult ewe pituitary gland concentration of Hg from amalgam was severalfold higher than brain concentration. This differential tendency was even more exacerbated in the fetal lamb. This finding is in agreement with Nylander (11), who reported relatively higher concentrations of Hg in pituitary compared with occipital brain of dentists. The endocrinological significance of amalgam Hg concentration in pituitary, thyroid, and adrenal glands in the present study should warrant further attention in future studies.

The present demonstration of selective concentration of amalgam Hg in cotyledon tissue with advancing gestational age is consistent with earlier evidence that elemental Hg from a nonamalgam source will traverse the placenta (2). This observation is supported by fetal blood Hg levels that are fourfold higher than maternal levels during the initial 2-wk phase after amalgam placement in this study. The sheep epitheliochorial placenta has six tissue layers separating fetal and maternal blood compared with the human hemochorial placenta with only three tissue layers, the latter placental barrier having transfer properties that can enhance its permeability (5). On this histological basis alone one might expect a human fetus to receive a greater proportion of a given dose of dental amalgam Hg than would a sheep fetus.

We conclude that Hg released from dental amalgam tooth fillings will begin to selectively accumulate in maternal and fetal tissues soon after amalgam placement. Accumulation of amalgam Hg progresses in tissues to a steady state with advancing gestation and is maintained for as long as 20 wk. Amalgam restorations are a source of continuous Hg exposure to both the mother and fetus. In view of the experimental evidence presented herein, continued employment of dental amalgam as a tooth restorative material in pregnant women and children should be reconsidered.

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Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm

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Abstract: For more than 160 years dentistry has used silver amalgam, which contains approximately 50% Hg metal, as the preferred tooth filling material. During the past decade medical research has demonstrated that this Hg is continuously released as vapor into mouth air; then it is inhaled, absorbed into body tissues, oxidized to ionic Hg, and finally covalently bound to cell proteins. Animal and human experiments demonstrate that the uptake, tissue distribution, and excretion of amalgam Hg is significant, and that dental amalgam is the major contributing source to Hg body burden in humans. Current research on the pathophysiological effects of amalgam Hg has focused upon the immune system, renal system, oral and intestinal bacteria, reproductive system, and the central nervous system. Research evidence does not support the notion of amalgam safety.—Lorscheider, F. L., Vimy, M. J., Summers, A. O. Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm. *FASEB J.* 9, 504–508 (1995)

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HISTORICAL OVERVIEW OF MERCURY USE IN DENTISTRY

As early as the 7th century, the Chinese used a "silver paste" containing mercury (Hg) to fill decayed teeth. Throughout the Middle Ages, alchemists in China and Europe observed that this mysterious silvery liquid, extracted from cinnabar ore, was volatile and would quickly disappear as a vapor when mildly heated. Alchemists were fascinated that at room temperature Hg appeared to "dissolve" powders of other metals such as silver, tin, and copper. By the early 1800s, the use of a Hg/silver paste as a tooth filling material was being popularized in England and France and it was eventually introduced into North America in the 1830s. Some early dental practitioners expressed concerns that the Hg/silver mixture (amalgam) expanded after setting, frequently fracturing the tooth or protruding above the cavity preparation, and thereby prevented proper jaw closure. Other dentists were concerned about mercurial poisoning, because it was already widely recognized that Hg exposure resulted in many overt side effects, including dementia and loss of motor coordination. By 1845, as a reflection of these concerns, the American Society of Dental Surgeons and several affiliated regional dental societies adopted a resolution that members sign a pledge not to use amalgam. Consequently, during the next decade some members of the society were suspended for the malpractice of using amalgam. But the advocates of amalgam eventually prevailed and membership in the American Society of Dental Surgeons declined, forcing it to disband in 1856. In its place arose the American Dental Association, founded in 1859, based on the advocacy of amalgam as a safe and desirable tooth filling material. Shortly thereafter, tin was added to the Hg/silver paste to counteract the expansion properties of the previous amalgam formula (1–3).

There were compelling economic reasons for promoting dental amalgam as a replacement for the other common filling materials of the day such as cement, lead, gold, and tinfoil. Amalgam's introduction meant that dental care would now be within the financial means of a much wider sector of the population, and because amalgam was simple and easy to use, dentists could readily be trained to treat the anticipated large number of new patients. By 1895, the dental amalgam mixture of metals had been modified further to control for expansion and contraction, and the basic formula has remained essentially unchanged since then (2, 3). Scientific concerns about amalgam safety initially surfaced in Germany during the 1920s, but eventually subsided without a clear resolution. At the present time, based on 1992 dental manufacturer specifications, amalgam (at mixing) typically contains approximately 50% metallic Hg, 35% silver, 9% tin, 6% copper, and a trace of zinc. Estimates of annual Hg usage by U.S. dentists range from approximately 100,000 kg in the 1970s to 70,000 kg today. Hg fillings continue to remain the material preferred by 92% of U.S. dentists for restoring posterior teeth (4,5). More than 100 million Hg fillings are placed each year in the U.S. Presently, organized dentistry has countered the controversy surrounding the use of Hg fillings by claiming that Hg reacts with the other amalgam metals to form a "biologically inactive substance" and by observing that dentists have not reported any adverse side effects in patients. Long-term use and popularity also continue to be offered as evidence of amalgam safety (6).

In light of the medical research evidence that has accumulated primarily over the past decade, the purpose of this review is to examine the traditional dental paradigm that maintains that amalgam is a biologically safe and appropriate tooth restorative material.

MERCURY EXPOSURE FROM AMALGAM FILLINGS

During the early 1980s several laboratories established that Hg vapor (Hg^0) is continuously released from amalgam tooth fillings, and that the rate of release into human mouth air is increased immediately after chewing (7–9) or tooth brushing (10). Mouth air levels of Hg^0 correlate significantly with the number of occlusal (biting) amalgam surfaces in molar teeth. Continuous chewing for 10–30 min results in a sustained elevation of the mouth Hg^0 level, which eventually declines to a baseline level 90 min

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after chewing cessation (11). Blood Hg levels also display a positive correlation with the number and total surface area of amalgam fillings (12).

A single amalgam filling with an average surface area of only 0.4 cm^2 is estimated to release as much as 15 μg Hg/day primarily through mechanical wear and evaporation, but also through dissolution into saliva (13). Recent electron microscopy images and electrochemistry data show direct evidence of amalgam Hg corrosion and leakage into saliva as free ions (14). Thus, for an average individual with eight occlusal amalgam fillings (11), a total of 120 μg Hg could be released daily into the mouth and a portion of this amount would be inhaled or swallowed. These estimations are consistent with a recent report showing that human subjects with an average number of amalgam fillings excrete approximately 60 μg Hg/day in feces (15), a portion of which is microparticles of amalgam. Various laboratories have estimated that the average daily body absorption of amalgam Hg in humans ranges between 1.2 and 27 μg (16), with levels for some individual subjects being as high as 100 μg/day. At the present time the consensus average estimate is 10 μg of amalgam Hg (range 3–17 μg) absorbed per day (17), an uptake amount corroborated by a more recent daily estimate of 12 μg (15). By way of contrast, estimates of the daily absorption of all forms of Hg from fish and seafood is 2.3 μg, and from other foods, air, and water is 0.3 μg (17). Thus, it is now proposed that dental amalgam tooth fillings are the major source of Hg exposure for the general population (17, 18). This position has been clearly validated by a recent demonstration that at least 65% of excretable Hg in human urine is derived solely from dental amalgams, and that amounts of Hg excreted also correlate with total amalgam surface area (19).

BODY TISSUE UPTAKE OF AMALGAM MERCURY

The degree to which body tissues can sequester amalgam Hg after exposure has been demonstrated in a variety of human and animal experiments. Human autopsy studies reveal significantly higher Hg concentrations in brain and kidney of subjects with aged amalgam fillings than in subjects who had no amalgam tooth restorations (20). When amalgam fillings containing a radioactive Hg tracer were placed in sheep molar teeth, a whole-body image scan performed 4 wk later demonstrated several possible uptake sites for Hg including oral tissues, jaw bone, lung, and gastrointestinal tract, with major localization of Hg in the kidney and liver (21). A similar whole-body image study repeated in a monkey (whose teeth, diet, feeding regimen, and chewing pattern more closely resemble those of humans) clearly demonstrates high levels of amalgam Hg in kidney, intestinal tract, and other tissues. The brain/CSF Hg ratio had increased threefold by 4 wk after amalgam fillings had been installed (22). The primate kidney will continue to accumulate amalgam Hg for at least 1 year after installation of such fillings (23).

Repeated observations in adult sheep (21, 24) demonstrate that after placement of amalgam fillings the blood Hg levels remain relatively low even though the surrounding body tissue concentrations of Hg become many fold higher than blood. This suggests that tissues rapidly sequester amalgam Hg at a rate equivalent to its initial appearance in the circulation. Such a phenomenon may explain why monitoring blood levels of Hg in humans is a poor indicator of the actual tissue body burden directly attributable to continuous low-dose Hg exposure from amalgam.

In pregnant sheep, which received amalgam fillings containing a radioactive Hg tracer, it was demonstrated that both maternal and fetal tissues began to accumulate amalgam Hg within several days after such fillings were installed. Maternal-fetal transfer of amalgam Hg was progressive with advancing gestation, and amalgam Hg also transferred to breast milk postpartum (24). More recently, human fetal/neonatal studies have likewise demonstrated that Hg concentrations in fetal kidney and liver, and cerebral cortex of infants, correlate significantly with the number of amalgam filled teeth of their mothers (25). This latter finding is consistent with previous animal studies that show greater Hg concentration in rat fetal tissues (and less placental retention) when the source of exposure was Hg^0 rather than mercuric salts (26).

CELL METABOLISM OF MERCURY

Major metabolic pathways

Figure 1 illustrates the major metabolic pathways for the three species of Hg. The principal source of Hg^0 is vapor from dental amalgam tooth fillings, whereas organic Hg (Hg^+) is derived principally from fish and seafood, and inorganic Hg (Hg^{2+}) originates from other foods, water, and air. Approximately 80% of inhaled Hg^0 is absorbed across the lung and converted to Hg^{2+} intracellularly by catalase oxidation. In contrast to other Hg species, the high lipid solubility of Hg^0 permits it to cross cell membranes readily, including the blood–brain barrier, and easily enter the brain. However, the kidney eventually becomes the major site of Hg accumulation during compartmental redistribution after exposure to Hg^0. Some Hg^0 is also dissolved in saliva and swallowed, converted to Hg^{2+} by peroxidase oxidation, and the majority is eliminated by fecal excretion. Other Hg^{2+} that is ingested in the diet is poorly absorbed across the intestinal tract and most is excreted in the feces. Although the majority of Hg^+ from the diet is also eliminated in the feces, a substantial portion is absorbed intracellularly as methyl-Hg^+. Both intracellular Hg^{2+} and Hg^+ are ultimately bound covalently to glutathione (GSH) and protein cysteine groups. Hg^{2+} is the toxic product responsible for the adverse effects of inhaled Hg^0. Body tissues have various retention half-lives for Hg^+ and Hg^{2+} ranging from days to years (15, 17, 26–28). After Hg is released from tissues, fecal excretion becomes the predominant route for elimination of Hg from the body. Human fecal excretion of

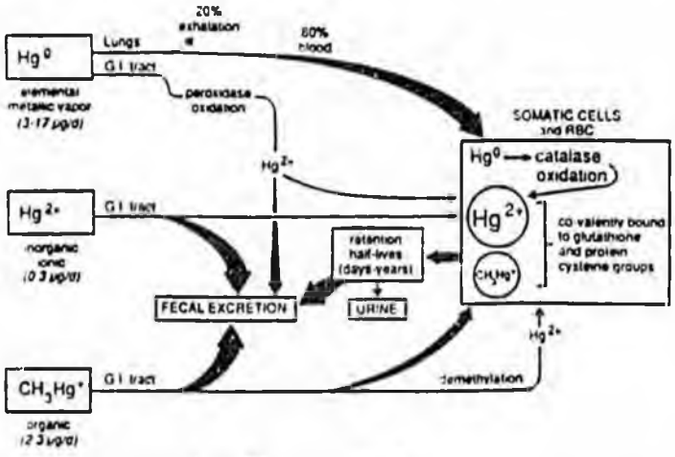

Figure 1. Metabolism of mercury species.

crease in the proportion of Hg-resistant bacteria in the floras of the intestine and oral cavity soon after installation of dental amalgam tooth fillings, an increase that persisted until the amalgam fillings were removed. The majority of these primate Hg resistant bacteria were also resistant to one or more commonly used antibiotics. Results show that Hg released from dental amalgam can enhance the prevalence of resistance to multiple antibiotics in the bacteria of the primate normal flora (40).

Reproductive system

The relationship of occupational exposure to Hg^0 and fertility of female dental assistants has recently been examined, because it is well established that long-term exposure to Hg^{2+} will alter reproductive cyclicity in rodents. Epidemiological screening by questionnaire of 7000 dental assistants showed that within an eligible subgroup of 418 women who were subsequently interviewed, fertility was reduced to only 63% that of control women not occupationally exposed to Hg^0. The study, while open to the criticism of all data that rely upon subject observation and opinion, concluded that dental assistants who prepared 30 or more amalgam fillings per week, and who also had poor Hg hygiene habits, were at risk of lowered fecundity (41).

Central nervous system

Initially suggestions occurred within medicine that neurodegenerative diseases could perhaps be linked to Hg from dental amalgam, but no experimental evidence was available at that time (42). However, it is now established that uptake and accumulation of amalgam Hg occur in monkey and human brain tissues (22, 27). Studies have demonstrated that Hg is selectively concentrated in human brain regions (medial basal nucleus, amygdala, and hippocampus) involved with memory function, and have suggested that Hg may be implicated (by mechanisms as yet unexplained) in the etiology of Alzheimer's disease (AD) (43, 44). Abnormal microtubule formation in AD brains has been associated with a defect in the tubulin polymerization cycle (45), which may increase the density of neurofibrillary tangles. A similar tubulin defect can be induced in the brain of $HgCl_2$-treated rats (46, 47), suggesting a connection between exposure to inorganic Hg and AD. $HgCl_2$ also markedly inhibits in vivo ADP-ribosylation of two rat brain cytoskeletal proteins, tubulin and actin, and thus alters a specific neurochemical reaction involved in maintaining brain neuron structure (48).

It is well established that Hg^+ will interact with tubulin resulting in disassembly of microtubules, and that microtubules function to maintain neurite structure (49). In a current investigation, recently reported, rats were exposed to Hg^0 4 h/day for as long as 14 consecutive days. Vapor exposure was maintained at 300 μg Hg/m³ air, a level detectable in mouths of some human subjects with large numbers of amalgam fillings. Average brain Hg concentrations increased significantly with duration of Hg^0 exposure. Photoaffinity labeling of the β-subunit of the tubulin dimer with $[\alpha^{32}P]8N_3GTP$ in brain homogenates was diminished by 75% after 14 days of Hg^0 exposure. An identical neurochemical lesion of similar magnitude was seen in human AD brain homogenates, but no direct evidence exists to prove that this lesion is the result of human exposure specifically to amalgam Hg. Because the rate of tubulin polymerization is dependent on binding of tubulin dimers to GTP, it was concluded that chronic inhalation of low-level Hg^0 in rats can inhibit the polymerization of tubulin essential for formation of microtubules (50).

Another recent report demonstrates subclinical neuropsychological and motor control effects from occupational exposure to Hg^0 over 1 year in a subpopulation of dentists with high urinary Hg levels (51). A more extensive report, evaluating dental technicians and dentists who received occupational exposure to Hg^0 and non-dental personnel controls, demonstrated that after a chelation drug (DMPS) challenge test urinary Hg levels were 16-fold higher in technicians and 6-fold higher in dentists compared to control subjects. Baseline urinary porphyrin levels measured before DMPS treatment were associated with urinary Hg levels obtained after the DMPS challenge. Urinary Hg was also adversely associated with several neurobehavioral changes in Hg-exposed subjects including impairment of attention tasks and motor perceptual tasks. The utility of a DMPS challenge to assess renal Hg burden was established (52).

CONCLUSIONS

The collective results of numerous research investigations over the past decade clearly demonstrate that the continuous release of Hg^0 from dental amalgam tooth fillings provides the major contribution to Hg body burden. The experimental evidence indicates that amalgam Hg has the potential to induce cell or organ pathophysiology. At the very least, the traditional dental paradigm, that amalgam is a chemically stable tooth restorative material and that the release of Hg from this material is insignificant, is without foundation. One dental authority states that materials are presently available that are suitable alternatives to Hg fillings (4). Based on recent immunology investigations (35), electrochemical corrosion experiments (14), and human metabolic studies (15) it appears that the use of silver in amalgam may be almost as questionable as is Hg, and this evidence suggests that it may be inappropriate to alternatively use recently developed Hg-free silver-containing dental metals (53) to fill teeth. It would seem that now is the time for dentistry to use composite (polymeric and ceramic) alternatives (4) and discard the metal alchemy bestowed on its profession from a less enlightened era. Although human experimental evidence is incomplete at the present time, the recent medical research findings presented herein strongly contradict the unsubstantiated opinions pronounced by various dental associations and related trade organizations, who offer assurances of amalgam safety to dental personnel and their patients without providing hard scientific data, including animal, cellular and molecular evidence, to support their claims (54). EJ

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Hg correlates significantly with the number of amalgam fillings, and the excretion rate for Hg in feces is 20 times higher than its corresponding excretion rate in urine. Even though fecal excretion of amalgam Hg predominates, this principal excretory route in humans shows a high correlation with urinary excretion of Hg. Fecal excretion rates for Hg in human subjects with amalgam tooth fillings can be as much as 100-fold higher than in subjects without such fillings (15).

Significance of glutathione and other sulfhydryl compounds

The major low molecular weight sulfhydryl compound in mammals is GSH, present at approximately 5 mM in cells, serum, and bile (29). Other low molecular weight sulfhydryls present at lower concentrations in cells include cysteine, biotin, lipoic acid, and coenzyme A. The major targets in proteins for binding of transition metals, including Hg, are the sulfhydryl group of cysteine and the imino nitrogen of histidine. The aromatic ring nitrogens of the nucleotide bases also form Hg complexes, with thymine and uracil being more reactive than cytosine, guanine, and adenine (30).

Whereas Hg^0 from amalgam is lipid soluble and freely passes through cell membranes, methyl and ionic Hg from food and other sources are both charged and therefore must be complexed with counter-ions or low molecular weight sulfur compounds in order to pass freely through the cell membrane.

The major cellular reaction potentiating the toxicity of Hg^0 is its oxidation by catalase, an enzyme found in all normal mammalian cells (31). This oxidation process can take place in any of the "barrier tissues" of the body as well as in the blood. Once generated within the cell by catalase, highly reactive Hg^{2+} will interact with a variety of nucleophilic ligands, the most abundant single nucleophile reactant being GSH. The sulfhydryl groups of proteins are next in abundance and avidity for Hg^{2+}, with the imino nitrogens of histidine and the nucleobases being substantially less reactive.

Despite the large molar excess of GSH, many proteins compete very effectively for binding of transition metals such as Zn, Ni, and Cu. The precise chemical basis for the high affinity of such metalloproteins is not understood: many of the currently well-defined members of this group, including important regulatory proteins, use cysteines and histidines as ligands to their respective metal cofactors (32). Thus, these proteins may exchange metals, including Hg, bound to GSH.

Once bound to GSH, Hg can leave the cell to circulate in serum or lymph and be deposited in other organs or tissues. GS-Hg-SG is eventually eliminated via either the kidney or downloaded via bile into the intestinal lumen and excreted in feces. After Hg leaves cells, its major route of elimination in any form (inorganic or organic) is via feces, with less than 10% of Hg normally exiting the body in urine (26). Experiments in sheep (21, 24) and monkey (22) indicate that 99% of amalgam Hg is excreted in feces, and in humans with 30 amalgam surfaces the average 24 h excretion rate for Hg in feces is 60 μg (95% of total daily excretable Hg) in contrast to 3 μg/24 h in urine (15). In mammals, half-lives from acute single doses of Hg^{2+} or methyl-Hg^+ range from months to years. Half-lives may differ with chronic Hg exposure as a result of compromised cellular function (e.g. kidney Hg turnover deceases with age and duration of exposure) (17, 26).

EFFECTS OF AMALGAM MERCURY ON CELL AND ORGAN SYSTEM FUNCTION

The overt clinical effects resulting from toxic exposure to the three species of Hg have been described (26, 28). Various animal and human experiments over the past several years have addressed the possibility of more subtle pathophysiological effects of amalgam Hg upon the function of several organ systems or cell types, including the immune system, renal system, oral and intestinal bacteria, reproductive system, and central nervous system.

Immune system

Ionic Hg has been shown to be antigenic and capable of inducing autoimmunity in rats (33, 34). In a very recent report, gelatin-encapsulated dental amalgam pieces were implanted intraperitoneally in an inbred strain of mice known to be genetically susceptible to Hg-induced immune pathology. Within 10 wk to 6 months the animals displayed hyperimmunoglobulinemia, serum autoantibodies that targeted nucleolar proteins, and systemic immune complex deposits. Similar changes were observed when only dental alloy (not containing Hg) was implanted, and these immune aberrations were attributed to the silver component of the alloy. This study concluded that both Hg and silver dissolution from dental amalgam can chronically stimulate the mouse immune system with subsequent induction of systemic autoimmunity (35). In humans, fecal excretion of silver is also correlated with the number of amalgam fillings (15). This would suggest that further investigation of the potential molecular effects of amalgam metals on the human immune system is warranted.

Renal system

Because human (20), monkey (22, 23), and sheep (21) kidney display significantly increased Hg concentrations after exposure to dental amalgam, some investigations have focused on what these concentrations may imply for renal function. Sheep with amalgam tooth filling implants show a reduced filtration rate of inulin, increased urinary excretion of sodium, and a decrease in urinary albumin (36). An increased sodium excretion has also been observed in monkeys similarly treated with amalgam fillings (unpublished data). Because Hg^{2+} accumulates primarily in the proximal tubule of rat (37) and rabbit (38) kidney and amalgam Hg in the proximal tubule of monkey kidney (23), where the majority of sodium is normally reabsorbed, increased excretion of sodium after placement of amalgam fillings in sheep (36) may reflect a reduced tubular capacity to conserve sodium selectively. Urinary albumin levels increased 1 year after removal of amalgam fillings in humans (12), whereas urine albumin levels fell in sheep after amalgam placement (36). It is uncertain whether these differences in albumin excretion patterns may reflect a Hg-induced reduction in renal blood flow due to the presence of amalgam fillings.

Oral and intestinal bacteria

It is well established that some human intestinal bacteria carry plasmids encoding resistance to both Hg and antibiotics (39). In a population subgroup of 356 persons who had no recent antibiotic exposure, those individuals with a high prevalence of Hg resistant bacteria in their intestinal flora were significantly more likely to display multiple antibiotic resistance in these same bacteria. A parallel investigation in monkeys demonstrated a marked in-

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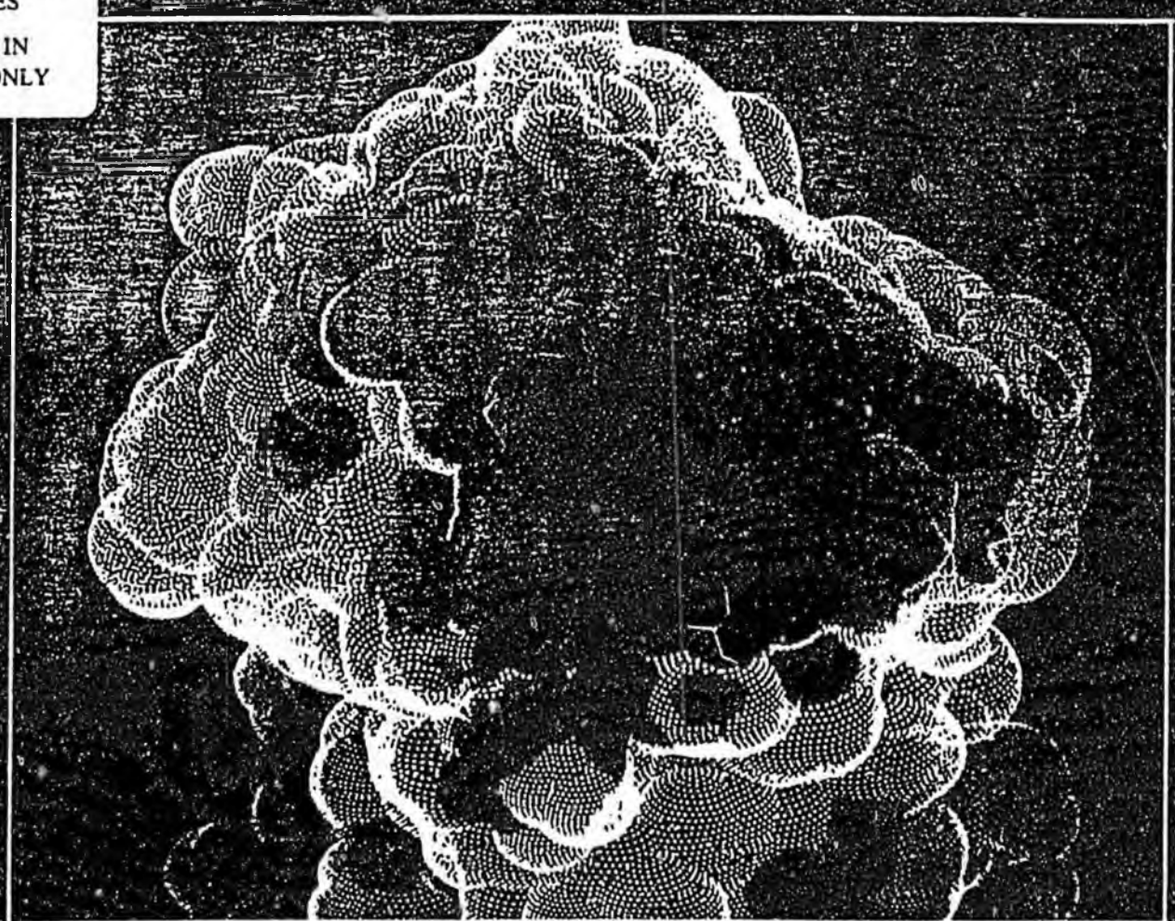

PARA-HYDROXYBENZOATE HYDROXYLASE

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Caco-2 cells as a model for intestinal lipoprotein synthesis and secretion. E. Levy, M. Mehran, and E. Seidman

COVER: One subunit of p-hydroxybenzoate hydroxylase. The image highlights the surface of the protein, which is cut away in one segment to reveal the flavin, substrate, and key active-site residues inside. (Image generated by Domenico L. Gatti.) See Entsch and van Berkel, pages 476-483.

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The Federation of American Societies for Experimental Biology (FASEB) seeks an Editor-in-Chief of *The FASEB Journal*. The first and current Editor-in-Chief, Dr. William J. Whelan, plans to retire from this position in June 1996 after 10 years of distinguished service.

The Federation of American Societies for Experimental Biology (FASEB) is a coalition of nine biomedical research societies in the disciplines of physiology, biochemistry and molecular biology, pharmacology and experimental therapeutics, investigative pathology, nutrition, immunology, cell biology, biophysics, and anatomy. *The FASEB Journal* is an official publication of the Federation designed to report on rapidly changing developments in the life sciences, and publishes state-of-the-art reviews and brief research communications in areas of interest to members of the FASEB Societies. Reviews focus on interdisciplinary aspects of growth points in life sciences research, and research communications emphasize innovative advances in methodology. In addition, the Journal features articles on public affairs and news items about research funding; people and institutions; a calendar of scientific meetings; and lists of currently released books and new products.

The FASEB Journal has a circulation of about 8,000. Impact factor data compiled by the Institute for Scientific Information indicates that *The FASEB Journal* ranks first out of 59 journals in the biology category, and 11th out of 173 journals in the category of biochemistry and molecular biology.

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cc:Mail for: Senator Lyda green

Subject: SB 90

From: rjcook@ptialaska.net ("Richard Cook") at CC2MHS1 4/4/97 5:22 PM

To: Senator Lyda Green at LAA_TRANS

Dear Senator Green,

SB 90

It has been suggested that the dental practice act be amended to allow dentists and patients to choose the restoration of their choice. I can tell you from personal experience, that there have been no problems whatsoever with a dentist such as myself or with my patients having the ability to place any restoration material they want. I am specifically referring to the choice of amalgam vs. other materials such as golds, porcelains, glass ionomers, any of the new glasses or composites.

I DO NOT USE AMALGAMS

I have not used amalgam in my practice for nearly 15 years. The last amalgam I placed was at the Alaska State Board exam many years ago. If a person in my practice needs to have a tooth restored or have an old amalgam replaced, I
usually suggest gold or porcelain. I always let my patients know what I would do for my own or my family's mouth as a preferred option.

AMALGAMS ARE SAFE AND EFFECTIVE

Amalgam restorations are safe, effective and relatively easy and cheap to do. The seems to be as well proven as anything can be well proven. That is the opinion of myself. As far as I know, that is the opinion of every dental and medical school in the world and of every legitimate world health organization.

I do have amalgam fillings in my own mouth and they have served me well for many
years. As long as there is no decay or corrosion or fractures, they will stay in my mouth. The same for my wife. I would never replace a perfectly good amalgam in my own family's mouth. If a replacement would be needed
however, I will choose gold.

FREEDOM OF CHOICE ALREADY EXISTS

Dentists or patients that do not use amalgam are not a problem to organized dentistry. Look at my practice. I replace amalgams every day with other materials. But I have a moral and ethical commitment to care for my patients with the same standards that I would my own family. If a patient wants to have amalgam fillings replaced for the "fun of it", I think that they have that right as long as the dentist has properly
informed the patient of the morbidity risks of removing a sound amalgam or any other perfectly good restoration. There is a small risk inherent in nearly any invasive dental procedure. Some of the risks are nerve damage, tooth sensitivity to hot and cold, and tooth weakening. If a tooth is perfectly OK, I do everything in my power to talk a person OUT OF replacing a filling. I tell them what I would do for myself or my family. Most people can relate to that easily.

Even though the risks are small, a procedure as simple as replacing an amalgam with a composite has some risks. Injections have risks. Each and

every time a restoration has been replaced it reduces the amount and strength of the remaining tooth structure.

PATIENTS HAVE FREEDOM TO CHOOSE, BUT DENTISTS DON'T HAVE FREEDOM TO DEFRAUD

However, and this is an important distinction, most mainstream dentists such as myself *do* have a problem with dentists who use their position of public trust to misrepresent what amalgam will or will not do. That is a polite way of saying that we strongly feel that a dentist should not be fraudulent. This why the legislature needs to maintain a Board of Dentists who can discipline those who are not being honest. There is a near hysteria that takes place from time to time in the media in which otherwise good people choose emotional appeal over scientific logic and proof. We believe that a dentist is unethical and dishonest if he uses the patients' emotional fears to influence his patients to replace sound restorations and produce more cash flow for his office. Being dishonest like that is just like the old-time elixir and snake oil salesmen who went from town to town selling the sure cure to everything. The salesman knows what he is doing is wrong but he just cannot resist the allure of more money.

THE (L&C) AMENDMENTS APPEAR REDUNDANT TO WHAT NOW EXISTS

If you look at the intent (as I perceive the intent) of the two amendments from the Labor and Commerce Committee, there is no change from what is now occurring. If a dentist is honest and open with his patients, and truthfully discusses the options with them, then there is no problem with organized dentistry or the Board of Dentists. Unfortunately not all dentists are 100% candid about the risks of removing sound restorations. That is why you have a Board of Dentists.

THE AMENDMENTS DO POSE A RISK IN INTERPRETATION

Care should be taken in any language of any bill so that it cannot be construed to prevent the Alaska Board of Dentists from protecting the public. I believe that the language of the amendments as they are now proposed present some problems. How do you demonstrate physical harm when it exists? I think that it would be difficult except in the rarest of cases. Even if the harm was the need to do a root canal six months later, how could you demonstrate that to a court of law? How could one prove it in a court of law? We do know that in general "drilling weakens teeth" and the more you drill, the less natural tooth structure is left. To me that is harm. But to a court, I just don't know.

Thank you for listening.

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