ALASKA LEGISLATURE COMMITTEE FILES 1991-1992 8672
7403 SENATE HEALTH EDUCATION & SOCIAL SERVICES

December 27, 1991

Dear H.E.S.S. Committee Member:

I am submitting this response to clarify some of the misinformation that was heard in testimony on Friday, November 22, 1991 on SB 123.

I will specifically respond to the Calgary Sheep Study on mercury from dental amalgams and to dietary mercury.

Sheep were selected as an animal model for the mercury amalgam vapor studies because:

1. they chew with their molars.

2. it has been acknowledged by the researchers that sheep may chew more than the average human but the purpose of this animal model was to demonstrate whether a phenomenom is valid under what may be exaggerated conditions such as bruxist (people grind/clench their teeth incessantly), habitual gum chewers, etc.

3. they were less expensive than primate studies (monkeys)

4. they are an excellent model to initiate the study

5. their availability for tissue biopsy and autopsy studies.

After the mercury amalgam contamination was discovered in the sheep model, experiments were then initiated in monkeys and humans.

INTRODUCTION TO THE SHEEP AND MONKEY STUDY

Please refer to the original 1989 **sheep** study "Dental silver tooth fillings: a source of mercury (Hg) exposure revealed by whole-body image scan and tissue analysis". Notice photograph on page 2643, figure 2.

Please refer to "Whole-body imaging of the distribution of mercury (Hg) released from dental fillings into **monkey** tissues." Turn to page 3258 figure 1.

Please note the simularities of research findings on the sheep study, page 2644,table 1 and page 3258 table 1 from the monkey study of mercury (Hg) contamination from amalgam fillings.

You will also see a copy of "Mercury from dental silver tooth fillings impairs sheep kidney function". Please note figure 1 on page R1011.

Both published sheep studies where critiqued as "flawed" on Friday, November 22 1991, testmony on S.B. 123.

The monkey study was never mentioned by the SB 123 antagonists because monkeys are excellent animals to study correlations with humans and, therefore, must be ignored by the opposition to improve their position.

Dietary Mercury as Compared to Dental Amalgam Mercury

As of May of 1991, there have been over 8 scientific studies actually measuring the amount of mercury vapor being released from amalgam dental fillings under various conditions. The most recent evaluation of ALL EXISTING DATA FROM AROUND THE WORLD is contained in the World Health Organization 1991 document titled *Environmental Health Criteria 118 - Inorganic Mercury*. The W.H.O. task group comprised of world-class toxicologists and scientists concluded that dental amalgams were the greatest source of mercury vapor exposure to humans. Dental amalgams are responsible in causing the daily intake and retention of mercury vapor.

Dental amalgam = 3.0 to 17.0 micrograms per day (mercury vapor)
Fish and seafood = 2.3 micrograms per day (methyl mercury)
Other foods = 0.3 micrograms per day (inorganic mercury)
Air and water = negligible traces

The committee also noted that, for mercury vapor, a specific no-observed-effect level (NOEL) could not be established, meaning that no level of exposure of mercury vapor can be considered harmless.

According to Craig's textbook on dental materials, the average amalgam contains 780 miligrams of mercury. So, if we accept the published research of the highest daily dose of mercury vapor, which is 27 micrograms per day, that would provide 9855 micrograms per year. 780 miligrams equates to 780,000 micrograms. If we divide 9855 into 780,000 we get 79.15. That means one amalgam dental filling could provide a human with 27 micrograms of noxious mercury vapor for 79 years!

Please review the enclosed article named "The Relationship between Mercury from Dental Amalgam and Mental Health" by Robert L. Siblerud M.S.. The mercury amalgam is the filling of choice at A.P.I.,our penal institutions, Public Health Service Dental Clinics, all Native Dental Clinics and Welfare Medicare Clinics.

These results were peer reviewed and published in prestigous scientific journals and are in marked contrast to *opinions* recently pronounced by the spokespeople for the dental profession and the American Dental Association.

I believe dentists have the responsibility to the dental consumer to make certain that they are aware of these facts. Our responsibility as health care professionals are to those that are most susceptible including women of conceptual age, pregnant women, nursing mothers, children, and those of compromised health.

We all have the **right to know** and the **right of freedom of choice** as American citizens and consumers.

I would, again, voice my support for SB 123.

Respectfully,

Burton A. Miller DDS

Burton A. Miller, D.D.S.

Encl: Dental "silver" tooth fillings:...
Whole-body imaging of the distribution....
Mercury from dental "silver" tooth....
The Relationship between Mercury....
Letter from University of So. Florida
Tape Cassette "The Quicksilver Smile"
Video Cassette "CBS News 60 Minutes "Is There Poison In Your Mouth" Airdate 12/16/90

SMILE
ALASKA

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SB 123 OPPOSED

November 27, 1991

Senator Arliss Sturgulewski
3111 C Street
Anchorage, Alaska 99503

Dear Senator Sturgulewski:

You are currently serving on a Senate committee that is reviewing SB 123, sponsored by Senator Pat Rodey. This bill states, "A licensee may not provide a dental filling without first obtaining written permission..."

I oppose this legislation for a number of reasons. First of all, targeting the dental profession, and specifically a filling material that has been used successfully for 150+ years is narrow minded. Every health care provider should inform his patients. Patients should be educated to question any and all treatment they receive.

The few dentists who are proponents of this legislation, I believe have faltering practices and see the amalgam controversy as a way to raise their productivity. These dentists test the levels of mercury in the amalgam fillings and charge for this service. Then, to counteract the supposed ill effects of the mercury, while removing the amalgam, they run an IV of Vitamin C which costs approximately $150.00 for each quadrant of the mouth that is done. These dentists advocate composite restorations, which do cost much more than amalgam fillings, because they take twice as long to place and the materials cost more. Composite restorations have a much higher instance of post-operative sensitivity, as the filling expands and contracts with temperatures at a different rate than the tooth. Composite restorations have improved greatly over the years, but the ADA states that removal of amalgams with a promise of curing physical ailments is unethical.

I hope that Alaska does not receive the distinction of being the first state to pass this far-reaching legislation through our Senate.

Sincerely,

Cheryl A. Ginn

Cheryl A. Ginn
3700 Carleton Avenue
Anchorage, Alaska 99517
(907)562-2512

4/65 3810

Alaska State Legislature

Please enter into the record my testimony to the HESS
committee name

committee on SB 123 , dated 5/17/91 .
bill/subject

I am sending current scientifically based article summaries concerning dental materials safety - specifically mercury amalgams.

Thank you

Signed: Patsy J. Hayes R.N.
Testifier

Representing (Optional)

3331 E Huffman Rd. Anchorage
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restorations were reinserted, there was a 24% reduction in T-lymphocytes and when they were again replaced with nonmetal fillings there was an improvement of over 30% in T-lymphocytes. The author concludes, though this study is small, that dental amalgam and nickel alloys can adversely affect the quantity of T-lymphocytes. Both nickel and mercury are toxic agents. The author suggests further research is needed for the frequency and magnitude of T-lymphocyte reduction and their alterations by dental materials. 9799

"Effect of Dental Amalgam and Nickel Alloys on T-Lymphocytes: Preliminary Report", Eggleston, David W., DDS, The Journal of Prosthetic Dentistry, May 1984;51(5):617-623. (Address: Dr. David W. Eggleston, 1441 Avocado Ave., #508, Newport Beach, CA

This letter is a rebuttal to the work by Larsson and Sagulin (Lancet, Nov. 17, 1990:1251) downplaying the role of fetal mercury exposure from maternal mercury amalgams. From sheep and monkey studies blood and urine concentrations of mercury from dental amalgams are poor indicators of higher tissue mercury concentrations. Comparably higher levels of mercury from amalgams are absorbed in the lung, intestinal tract and jaw bone and with chronic low dose exposure of four to 20 weeks mercury from amalgams in sheep show high concentrations of this metal in the kidneys and liver. The authors note that the fetus may be more sensitive to mercury toxicity than the adult and therefore less exposure could still have a higher risk. Comparing acute mercury exposure to chronic low dose mercury from amalgams may be not be valid. Chronic low dose exposure from mercury vapor may be more efficiently absorbed than higher acute doses. Higher acute doses may not be transferred to the fetus as efficiently as low dose chronic exposure. These authors doubt that the fetal liver can render mercury unavailable for uptake by other organs. Fetal mercury stored in the fetal liver may be shunted to other tissues such as the kidney and the brain. The authors refer back to their primate studies showing that dental amalgams release more mercury vapor and more mercury is absorbed in other tissues than was previously thought. They state that experimental evidence suggests that dental "silver" mercury amalgams should not be put in pregnant females. 11248

"Mercury From Dental Amalgams", Lorscheider, F.L. and Vimy, M.J., The Lancet, December 22/29, 1990;1578-1579. (Address: F.L. Lorscheider, Departments of Medical Physiology and Medicine, Faculty of Medicine, University of Calgary, Calgary, Alberta Canada T2N 3N1)

Mercury and Brain Tissue

Examination of cadaver dentition and collection of brain tissue was done in a nonrandomized trial of sudden death subjects in routine autopsy procedures at the Los Angeles County Coroners Office. Control cadavers had zero to one occlusal surface of dental amalgams and a minimum of 14 posterior teeth while analyzed subjects had a minimum of five occlusal surfaces and a minimum of ten posterior teeth. Only occlusal surfaces were considered because of the effects of mastication on mercury release from dental amalgams. Their data showed a positive correlation between the number of occlusal surfaces of dental amalgams and mercury levels in the brain. Exposure of a seven month old fetus to mercury from a gravid cadaver containing 14 surfaces of dental amalgam of which nine were occlusal surfaces showed brain mercury content though to a lesser degree than the mother. The authors note that they do not know the toxic or teratogenic levels of mercury in human fetal brain tissue but recommend against the removal or insertion of dental amalgams from gravid patients or women of childbearing age with the possibility of pregnancy whenever possible. One trauma victim had

severely high levels of mercury in the brain and it was suggested that emergency room physicians might check blood levels of mercury in survivors of major trauma to the oral cavity with the presence of dental amalgams. Mercury was also found in the kidney and in the liver which indicates a general systemic contamination. 9970

"Correlation of Dental Amalgam With Mercury in Brain Tissue", Eggleston, David W., DDS and Nylander, Magnus, DDS, The Journal of Prosthetic Dentistry, December 1987;58(6):704-707. (Address: Dr. David W. Eggleston, 1441 Avocado Avenue, #508, Newport Beach, CA 92660, U.S.A.)

Mercury and Dental Personnel

Dental personnel with high urine mercury levels were compared with personnel in the same clinics with low urinary mercury levels. It was found that among professionals handling mercury amalgams urinary mercury was related more to the number of amalgam surfaces than the general environmental contact. Plasma selenium and erythrocyte glutathione peroxidase levels were unchanged by mercury levels. 6161

"Mercury, Selenium and Glutathione Peroxidase in Dental Personnel", Molin, Margareta, et al, Acta Odontol. Scand., 1989;47:383-389. (Address: Margareta Molin, Department of Prosthetic Dentistry, University of Umea, S-901 87, Umea, Sweden)

Mercury and Health

Mercury comprises over 50% of silver dental amalgams. Mercury vapor is released from fillings particularly after chewing, bruxism, hot and/or acidic food and tooth brushing. Mercury is a powerful biological poison and extremely toxic. It is more toxic than lead, cadmium and arsenic. The release of mercury from dental amalgams is probably the most significant cause of human exposure to inorganic mercury. Autopsy study shows positive correlation between the number of occlusal surfaces of dental amalgams and mercury levels in the brain and kidney cortex. Mercury amalgams have been shown to affect T-lymphocyte function. Upon their removal T-lymphocytes have improved in number and have decreased upon reinsertion. Multiple sclerosis patients have been found to have up to eight times higher levels of mercury in their CSF than neurologically healthy controls. Scrap dental amalgam was declared a hazardous waste in 1988 by the Environmental Protection Agency. Outside of your mouth it has to be: 1. Stored in unbreakable, tightly sealed containers away from heat. 2. It is not to be touched. 3. Stored under liquid glycerine or photographic fixer solution. So the paradox is once it is taken out of the mouth it is toxic and when it is placed in the teeth it is "nontoxic". Amalgam fillings have been tested for their strength but never for their safety. The American Dental Association has not produced studies showing their safety. Just because they have been used so prevalently over the years, does not mean they are safe. The author equates the same analogy for radiation being considered safe for so many years in the days of shoe fluoroscopy. Dentists have the highest rates of suicide and divorce among professionals. At the University of North Texas, Gerald Butler, Ph.D., found neuropsychological dysfunction in 90% of dentists tested. Female dental personnel have higher rates of spontaneous abortion, raised incidence of premature labor and elevated perinatal mortality. Elemental mercury does cross the placenta. A Polish study of 81 females, 45 dentists and 36 dental assistants found that hair mercury levels were much greater than in 34 nonexposed controls. There was a positive correlation between

total mercury levels and reproductive failures as with the prevalence of menstrual cycle disorders. There was a high incidence of spina bifida births in his study (5 out of 117 pregnancies). Folic acid deficiency has been associated with spina bifida and mercury is a known inhibitor of folate metabolism in the body. Dentists have one of the highest utilization rates of medical insurance according to the industry. Since chronic mercury exposure is subtle rarely do dentists and dental personnel get assessed for mercury for their medical complaints. Unfortunately, low level mercury excess is difficult to diagnosis. Urinary mercury levels can be low in chronic exposure. Blood levels are not helpful since mercury remains in the blood for only minutes. Mercury is usually deposited in soft tissue such as the brain, adrenals, thyroid and other organs. There has been a documented increased mercury uptake in the pituitary gland of dentists. Over 100 million people have mercury fillings in their mouth. Public hearings regarding the toxicity of amalgam fillings by the Swedish Governmental Health Board were upheld stating that amalgams are toxic and are unsuitable for use in dental fillings. 8799

"The Mercury Cover-Up: Controversies in Dentistry", Denton, Sandra, M.D., Townsend Letter For Doctors, July 1990;488-491. (Address: Sandra Denton, M.D., 615 E. 82nd Street, #300 Anchorage, AK 99518, U.S.A.)

Mercury, Selenium and Glutathione Peroxidase

Ten healthy individuals' amalgam fillings were replaced by gold inlays. Ten evaluations in a 16 month period, four months before and 12 months after amalgam removal showed a strong statistically significant correlation between plasma mercury values and the total number of amalgam surfaces, and the total surface area of fillings. In the immediate post removal phase plasma mercury rose three to four fold whereas urinary and erythrocyte mercury rose 50%. These values declined to preremoval levels at about one month. Twelve months after removal of the amalgams plasma and urinary mercury levels were significantly reduced to 50% and 25% respectively from the initial values in the experimental group. There was no significant change in selenium status except at five and ten days after removal. These results show that mercury from amalgam fillings can contribute significantly to mercury concentrations in the plasma and urine. No biological effects from this mercury were noted. 10623

"Mercury, Selenium, and Glutathione Peroxidase Before and After Amalgam Removal in Man", Molin, Margareta, ACTA Odontol. Scand., 1990;48:189-202. (Address: Margareta Molin, Department of Prosthetic Dentistry, University of Umea, S-901 87, Umea, Sweden)

Eight healthy individuals who had no amalgam restorations developed serious caries and amalgams were put in place. The mean number of restored surfaces were 16.1 and the mean amount of mercury inserted was 2.9 gm. There was no change in plasma mercury one and three months after placement. Urinary mercury after placement increased continuously compared to the mean preplacement value. No correlations were found between plasma and urinary mercury concentrations and the number of amalgam fillings. Selenium and erythrocyte glutathione peroxidase levels did not change. These results show that mercury amalgams are an important source of exposure from inorganic mercury resulting in elevated urinary levels without affecting selenium status in man. 10622

"The Influence of Dental Amalgam Placement on Mercury, Selenium and

Glutathione Peroxidase in Man", Molin, Margareta, et al, ACTA Odontol. Scand., 1990;48:287-295. (Address: Margareta Molin, Department of Prosthetic Dentistry, University of Umea, S-901 87 Umea Sweden)

Mercury Tissue Concentrations

Mercury vapor is released from amalgams after chewing and even with brushing of the teeth. There is a positive correlation between the amount of mercury vapor in the mouth and the number of amalgam surfaces. Mercury has been demonstrated in sheep models, using radioactive isotopes, to be deposited in organs and other tissues within 29 days. Areas of uptake include the lung, gastrointestinal tract and jaw tissue. The mercury from the amalgams localizes in the kidneys and liver. Amalgams remain in human teeth on the average eight to ten years. The author discusses these findings and concludes that mercury amalgams are a major source of chronic mercury exposure. Since in North America 100,000 kgs are used each year in dentistry the health effects need to further be studied. It has been estimated that 5.4% of the population of North America has a contact hypersensitivity to mercury. 10810

"A Source of Mercury Exposure Revealed by Whole-Body Image Scan and Tissue Analysis", Lorscheidar, Fritz L., Townsend Letter For Doctors, December 1990;840-841. (Address: Fritz L. Lorscheider, Department of Medical Physiology, Faculty of Medicine, Health Sciences Center, University of Calgary, 3300 Hospital Dr. N.W. Calgary, Alberta T2N 4N1, Canada)

Mercury Vapor

This is an in vitro study of the rate of mercury vapor release from different types of amalgam fillings. Polished, oxidized and corroded amalgams were evaluated. There were differences in vapor released between polished amalgams stored in air and amalgams coated in artificial saliva. Single composition type amalgams release more mercury than conventional or disbursed ones. Increased temperatures raised and water lowered vapor rates. Amalgam surfaces brushed with toothpaste resulted in an instant increase of mercury vapor. 6518

"Mercury Vapor From Dental Amalgams, an In Vitro Study", Derand, Tore, Swedish Dentistry Journal, 1989;13:169-175. (Address: Tore Berand, Institutionen For Odontologisk Teknologi, Tandlakarhogskolin, S-214 21 Malmo, Sweden)

Placental Transfer of Mercury

These authors refute the idea that placental transfer of mercury amalgam to the fetus is a health problem and do not recommend the restriction of amalgam placement in pregnant patients or work limitations for dental staff who have good hygiene. They report that the fetal exposure to mercury does not exceed that of the mother. The daily uptake of mercury from amalgams is low at 2-5 ug, as is occupational exposure. 10864

"Placental Transfer of Mercury From Amalgam", Larsson, K.S. and Sagulin, G.B., The Lancet, November 17, 1990;336:1251. (Address: K.S. Larsson/G. B. Sagulin, Department of Odontological Toxicology, Karolinska Institute, S-141 04 Huddinge, Sweden)

Primate Organs and Mercury Concentrations

In this primate study three subjects received occlusal amalgam fillings, three bone implants of amalgam and three untreated monkeys served as controls. After one year they were sacrificed and

evaluated for organdeposition of mercury. Amalgam fillings were associated with mercury deposition in the spinal ganglia, anterior pituitary, adrenal medulla, liver, kidney, lungs, and intestinal lymph glands. In the animals that had the silver amalgam bone implants the mercury was found in the same organs except for the liver, lungs and intestinal lymph glands. The three control animals were devoid of mercury. These results strongly support that dental fillings in primates result in absorbed mercury. The absorption of mercury probably occurs through the lungs and intestinal tract, and depending on the degree of exposure, is distributed to most organs and will eventually be found in the nervous system. The silver release from the amalgams was not absorbed. 9395

"Traces of Mercury in Organs From Primates With Amalgam Fillings", Danscher, Gorm, et al, Experimental and Molecular Pathology, 1990;52:291-299. (Address: Gorm Danscher, Department of Neurobiology, Institute of Anatomy, University of Aarhus, Royal Dental College, Aarhus, Denmark)

Swedish Ban and Assessment

It was reported in the Swedish Newspaper Dagens Nyheter, October 6, 1989 by the director of chemical inspection that mercury amalgam will be banned in Sweden by 1991. Recently in Tuscon, Arizona seven dentists' offices were closed by the EPA due to mercury in the sewage treatment plant whose primary source came from the drains of these dentists' offices. The EPA documented by a standard two molar acid technique that mercury in the dentists' suction pumps was being released. It is interesting to note that teeth covered with plaque have a significant amount of acid production and this is a possible explanation of why old amalgams have lost 25% to 50% of their mercury. In Berlin 13% of mercury discharged at sewer treatment plants comes from dental clinics. In Japan several dental schools have had problems complying with their EPA standards for mercury disposal and have stopped using mercury fillings. A recent report by Dr. Mats Hanson, PhD in neurobiology and specialist in mercurial poisoning sheds new information on body-burden mercury assessment. He translated a German article by M. Daunderer, M.D. for the diagnosis and treatment of mercurial poisoning which utilizes Dimaval (DMPS). This is a chelator which has been used in the USSR since 1957 and West Germany for heavy metal poisoning. A urine sample is taken before treatment followed by an IV injection of IV DMPS 3 mg/kg body weight and after 30 minutes another urine sample is taken. Less than 4 mcg/L of mercury are seen in the urine normally. If urinary mercury increases to more than 50 mcg/L this is definite proof of accumulation of mercury in organs and the brain. He has found values up to 2565 mcg/L in the urine and the build-up is related to the number of mercury/silver fillings. Neurologic problems can occur in values greater than 50 mcg/L. This drug is not currently available in the U.S.. 6915

"Sweden Bans Amalgam After 1991", Kennedy, David, D.D.S., Health Consciousness, February 1990;49-54/Mobilization Tests For Environmental Metal Poisoning, Daunderer, M., M.D., Forum Des Praktischen Und Allgemedn-Aarztes, 1989;28(3):88. (Address: David C. Kennedy, D.D.S., 2425 3rd Avenue, San Diego, CA 92101, U.S.A.)

T-Lymphocytes

This was a review of 3 patients between the ages of 20 and 35 who had T-lymphocyte studies done before and after amalgam removal. In all 3 cases there was a significant increase in the number of T-lymphocytes ranging from 18% to 55%. In one case, when the amalgam

Cynthia Clinkscales
P.O. Box 1043
Homer, AK 99603

April 23, 1991

Senator Paul Fischer
Alaska State Legislature
P.O. Box V (MS 3100)
Juneau, AK 99811

Re: Senate Bill 123
Informed consent for the use of mercury in dental fillings

Dear Senator Fischer:

Well, a lot has happened since last year and the campaign to pass S.R. 12 (legislation similar to S.B. 123). A recent "60 Minutes" segment on the dangers of mercury/silver fillings generated the greatest response received by the program to date. The scientific data and research are now in. Mercury does migrate from the teeth and it does deposit in the brain, liver, kidneys and other organs.

Did you know that autopsy studies correlate the amount of mercury in internal organs to the number of mercury amalgams in the mouth? Mercury can also pass the placental barrier and is introduced to the baby through mother's milk. Dentists and dental personnel in Sweden were found to have twice the incidence of brain tumors as non-dental personnel.

It is undeniable that citizens should have the right to choose the type of dental materials to be used in their mouths. However, suppose people are unaware that they have a choice or that there is any need to make a choice? This situation is the equivalent of being denied that right of choice.

Even many dentists are largely unaware of the amount of research and evidence which has been gathered. This research concludes that mercury is not as safe as claimed by the American Dental Association (ADA). David Kennedy, D.D.S. recently stated in a magazine article that "To this day, few of the facts reviewed in this presentation are common knowledge among dentists. New graduates are equally unfamiliar with the problems I have discussed". (Health Consciousness, April 1991)

When those in a position of power refuse to take a realistic view of a problem, and those who deal with the issue on a daily basis (practicing dentists) are unaware of the dangers or the results of legitimate research, what happens to the patient? Does anyone care about the patient? This is why citizens and health practitioners are asking

for this legislation. Those of us who know about the mercury problem are suggesting that the majority of the population which doesn't know should be informed. Once informed, they have been given the right of choice. Is that too much to ask?

Sincerely,

Cynthia Christensen

Enclosure: Letter dated Feb. 20, 1990

cc: Representative Mike Navarre

Representative Gail Phillips

Senator Arlis Sturgulewski, Chair, HESS Committee

HESS Committee: Senators Sam Cotten, Lyman Hoffman, Curt Menard

Senator Patrick Rodey

Governor Walter Hickel
P.O. Box A
Juneau, AK 99811

Bob Stephenson
DAMS (Dental Amalgam Mercury Syndrome of Alaska)
1837 No Way Lane
Fairbanks, AK 99709

Jim Roderick
Cook Inlet Vigil
P.O. Box 916
Homer, AK 99603

Cynthia Clinkscales
P.O. Box 1043
Homer, AK 99603

February 20, 1990

Senator Paul Fischer
Chairman, Senate HESS Committee
P.O. Box V
Juneau, AK 99811

Re: Senate Resolution 12
Informed consent regarding the use of mercury in dental fillings

Dear Senator Fischer:

I participated in the teleconference on February 12 before the Senate HESS Committee regarding Senate Resolution 12. I must express my extreme disappointment in the committee's decision not to pass S.R. 12 as written. I hope that through your efforts, or the efforts of others, S.R. 12 will be supported and passed in its original form.

Dental patients have the right to know that a significant amount of mercury (about 50%) is being used in "silver" fillings. Even the American Dental Association agrees that mercury does not remain completely inert in the tooth. But they claim that this is only a problem for a small percentage of people who have an "allergy" to mercury.

I believe this ADA position is ludicrous because 1) the percentage of people sensitive to mercury has been shown to be significantly higher than the percentages claimed, and 2) <u>one does not have to be allergic to a poison to be harmed by it</u>. I'm not allergic to arsenic, so does that mean I can safely have arsenic implanted in my teeth and let it slowly leach out into my body? Of course not. But this is what is happening with the mercury filling.

People who have suffered with mercury toxiciy from dental fillings, and the health professionals who help them, find it exasperating and distressing that unwarranted opposition continues to even just informing a patient about mercury in amalgams. And now that alternative materials are available, patients have every right to know about the potential hazards of mercury, so that an informed choice can be made.

It is imperative that the government take action now on this problem because the profession appears to be unwilling or unable to deal with it. It is often difficult for human beings to admit mistakes. Even an honest mistake can progress from a molehill to a mountain until it is almost too late to make any changes.

But the time for change is now. The situation humankind has gotten itself into with mercury in fillings boggles the mind. It is so mind-boggling that it is easier for some people to deny that a problem exists than to try to solve it.

I hope that you will have the courage to take one small step toward solving this problem by supporting S.R. 12. Very few people are aware that so-called "silver" fillings actually contain more mercury than silver. Otherwise, the public outcry would be much greater.

Sincerely,

Cynthia Clinton

cc: Senate HESS Committee: Jim Duncan, Tim Kelly, Al Adams, Lloyd Jones

Rep. Johnny Ellis
Chairman, House HESS Committee

Governor Steve Cowper
P.O. Box A
Juneau, AK 99811

Myra Munson
Commissioner, Dept. of Health & Social Services
P.O. Box H
Juneau, AK 99811-0601

Rep. Mike Navarre

Rep. C.E. Swackhammer

Robert Stephenson
DAMS (Dental Amalgam Mercury Syndrome) of Alaska
1837 No Way Lane
Fairbanks, AK 99709

STATE OF ALASKA

LEGISLATIVE AFFAIRS AGENCY

DIVISION OF PUBLIC SERVICES

DATE: November 22, 1991

Please accept the enclosed original(s) of written testimony for the Ft. Health, Education & Social Svcs teleconference hearing that was scheduled on November 22, 1991.

A copy of this testimony was transmitted to your committee via fax on November 22, 1991.

Thank you,

Christi Shedde
Info Assistant
Fbks. AK.

Alaska State Legislature

Please enter into the record my testimony to the Senate Hess
committee name

committee on S.B. 123 , dated November 22, 1991.
bill/subject

I strongly support the passage of SB 123 and think such a measure is long overdue. It is abundantly clear that certain dental materials, notably mercury, pose serious health risks, at least to some people. It has been scientifically established that mercury amalgam fillings, for example, are the primary source of exposure to mercury for the general population. Most recently, the World Health Organization has published this conclusion based on research done by world recognized experts in the toxicology.

In recent years organized dentistry has displayed a tremendous resistance to meeting what should be a professional and fiduciary duty to their patients to advise them of treatment options and potential risks. This is not something that should be left to chance, and should have been done all along. It is not right to leave this matter solely to the dentists choice, since dentists differ in their willingness and ability to provide accurate information to patients, and their trade union, the NEA, has taken a stand against that.

Dental patients should be accorded the same "right to know" as people using prescribed or OTC drugs, or handling hazardous substances in other situations. Dentistry is the only profession that routinely implants foreign substances in the human body, and it is now clear many of these substances are by no means, benign. Please take action in the interests of the public, and one that will help move the dental profession into an era of enlightment.

Thank you.

Signed: _____
Testifier Bob Stephenson

Self
Representing (Optional)

1837 Ho Way Lane, Fairbanks, AK. 99709
Address

907-455-6401 (H) 456-5156 (wk)
Phone No.

9/88 Legislative Information Office

Alaska State Legislature

Please enter into the record my testimony to the Senate/House Health, Ed, SS
committee name

committee on SB 123 , dated 11/22/91 .
bill/subject

I support adoption of SB 123 and ask that your committee recommend it's passage by the full legislature. I have read a great many of the published, refereed scientific papers on the deleterious effects of mercury from amalgam fillings. Unfortunately, the general public is largely unaware of these effects, consequently a special effort should be made to insure that the public is made aware of potential health problems arising from dental filling materials, especially amalgam fillings. The facts are (1) amalgam fillings release mercury vapor, (2) this mercury is absorbed by the body, especially in critical organs like endocrine glands and the kidney and (3) this mercury (in small amounts) accumulates and disrupts or damages normal functioning of these tissues.

Signed: HERBERT R. MELCHIOR
Testifier

SELF
Representing (Optional)

2721 HORSETAIL TRAIL
Address FAIRBANKS, AK 99709

455-6615
Phone No.

Alaska State Legislature

Please enter into the record my testimony to the Pupil-Teacher RATIO
committee name

committee on _____ bill/subject . dated 11/20/91 .

KEEP or Do WHAT EVER NESS & GARY ~~LEGISLATE~~
~~TEACH~~ To LIMIT 25 pupils to each
TEACHER, NO MORE.

Signed: Hugh Keogan
Testifier

Representing (Optional)
359 STATE ST. JUN 99701

Address
465 1869

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Alaska State Legislature

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Senate Committee on
Health, Education and Social Services

March 3, 1992

Dr. Robert Warren
625 E. 34th Avenue
Anchorage, Alaska 99503

Dear Dr. Warren:

I wanted to let you know that SB 123 "An Act requiring a dentist to obtain informed consent for dental fillings" is currently in the Senate Health, Education, and Social Services Committee of which I am chairman. With the consent of the sponsor, SB 123 will not move out of this committee during this legislature and that means the legislation is dead--at least for this time around.

I appreciate your interest in SB 123. Again, I am sorry about the video tape loss.

Sincerely yours,

Arliss

Senator Arliss Sturgulewski, Chairman
Senate Health, Education and Social Services Committee

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: TORIE HEART
TITLE:
ADDRESS: 3214 MURIEL PLACE
CITY: ANC ZIP: 99517
PHONE: 272-3416
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: VOTE IN SUPPORT OF SB 123. /LD

POMID: 03120010
DATE: 91/05/15
TIME: 12:00:10
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: BRIAN HALL
TITLE:
ADDRESS: 3805 IOWA, #2
CITY: ANCHORAGE ZIP: 99517
PHONE: 248-7916
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: PLEASE SUPPORT SB 123. I THINK THIS IS A GOOD FIRST STEP. I BELIEVE THE AMALGAM SHOULD BE BANNED ALTOGETHER. THERE ARE OTHER FILLINGS THAT CAN BE USED WITHOUT EXPOSING PEOPLE TO HAZARDOUS MATERIALS. /BN

POMID: 03134611
DATE: 91/05/15
TIME: 13:46:11
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: ERIKA MAHANEY
TITLE:
ADDRESS: 608 N. PINE
CITY: ANCHORAGE ZIP: 99508
PHONE: 274-9492
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I STRONGLY SUPPORT SB 123 AND PLEASE MOVE OUT OF COMMITTEE. I WOULD LIKE TO HAVE YOUR COMMENTS REGARDING SB 123. /BN

POMID: 03142544
DATE: 91/05/10
TIME: 14:25:44
LIONAME: ANCHORAGE LIO

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GONZALES	

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: CATHY WOOD
TITLE:
ADDRESS: 3902 IOWA
CITY: ANC ZIP: 99517
PHONE: 243-6660
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I SUPPORT SB 123. /LD

POMID: 03131855
DATE: 91/04/30
TIME: 13:18:55
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: JOY ANDERSON
TITLE:
ADDRESS: 6242 W. DIMOND BLVD.
CITY: ANC ZIP: 99502
PHONE: 243-5474
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I SUPPORT THIS BILL. AND I FEEL IT'S OUR RIGHT TO KNOW. /LD

POMID: 03085652
DATE: 91/05/03
TIME: 08:56:52
LIONAGE: ANCHORAGE LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: GLENDA BRUNDIDGE
TITLE:
ADDRESS: 505 FISCHER,#1
CITY: ANCHORAGE ZIP: 99518
PHONE: 562-2269
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I WOULD LIKE TO SEE THIS LEGISLATION GO FORWARD BECAUSE THE MERCURY TOXICITY HAS BEEN PROVEN TO BE A DANGER TO OUR HEALTH. /CME

POMID: 03090015
DATE: 91/05/03
TIME: 09:00:15
LIONAME: ANCHORAGE LIO

COPIES: SENATOR

RODEY

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: HILDA MELCHIOR
TITLE:
ADDRESS: 2721 HORSETAIL TRAIL
CITY: FAIRBANKS ZIP: 99709
PHONE: 455-6615
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: PLEASE SUPPORT SB 123 INFORMED CONSENT BILL. PEOPLE SHOULD HAVE KNOWLEDGE OF, AND A CHOICE OF WHAT IS PUT INTO THEIR BODIES. THANK YOU.
EOM/CLS

POMID: 07085906
DATE: 91/05/03
TIME: 08:59:06
LIONAME: FAIRBANKS LIO

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	HOFFMAN
	MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: HOMER DOTY
TITLE:
ADDRESS: PO BOX 75207
CITY: FAIRBANKS ZIP: 99707
PHONE: 451-2241
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: PLEASE PASS THIS BILL AND MAKE THE DOCTORS AND DENTISTS AND MEDICAL PEOPLE TELL YOU WHAT THEY ARE GOING TO DO TO YOU BEFORE THEY DO IT. EOM/MJO

POMID: 07090412
DATE: 91/05/03
TIME: 09:04:12
LIONAME: FAIRBANKS LIO

COPIES: SENATORS

FAHRENKAMP
FRANK
SHULTZ
FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: ROSALEE RUSSELL
TITLE:
ADDRESS: P.O.BOX 141892
CITY: ANCHORAGE ZIP: 99514
PHONE: 248-7533
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I AM IN SUPPORT OF MANDATING THAT DENTISTS INFORMED THEIR PATIENTS EXACTLY WHAT MATERIALS WILL BE PLACED IN THEIR MOUTHS AND THE POTENTIAL COMPLICATIONS AND WHAT ALTERNATIVES ARE AVAILABLE. /CMR

POMID: 03091253
DATE: 91/05/03
TIME: 09:12:53
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: SHAUN GROSE
TITLE:
ADDRESS: 637 CLOUD ROAD
CITY: NORTH POLE ZIP: 99705
PHONE: 488-8956
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: BECAUSE OF THE AMOUNT OF TRUST THAT WE PUT IN OUR DENTISTS, IT IS IMPORTANT THAT WE HAVE THE OPPPORTUNITY OF INFORMED CONSENT IN DENTAL MATERIALS. THANK YOU. EOM/CLS

POMID: 07094553
DATE: 91/05/03
TIME: 09:45:53
LIONAME: FAIRBANKS LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: KENT MONROE
TITLE:
ADDRESS: 1977 WESTON DRIVE
CITY: FAIRBANKS ZIP: 99709
PHONE: 474-4692
BILL NO:
SUBJECT:
MESSAGE: I SUPPORT SB 123. I THINK DENTAL PATIENTS SHOULD BE MADE A AWARE OF POTENTIAL HAZARDS ASSOCIATED WITH AMALGAM FILLINGS AND INFORMED OF THE AVAILABLE OPTIONS SO THAT THEY CAN MAKE AN INFORMED CHOICE. EOM/MJO

POMID: 07102110
DATE: 91/05/03
TIME: 10:21:10
LIONAME: FAIRBANKS LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: HERBERT R. MELCHIOR
TITLE:
ADDRESS: 2721 HORSETAIL TRAIL
CITY: FAIRBANKS ZIP: 99709
PHONE: 455-6615
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: PLEASE SUPPORT AND VOTE FOR SB 123. RECENT RESEARCH SHOWS SOME DENTAL MATERIALS ARE OR MAY BE HAZARDOUS TO HUMAN HEALTH. DENTAL PATIENTS SHOULD BE TOLD ABOUT POSSIBLE PROBLEMS AND GIVEN A CHOICE. DENTISTS CAN RECEIVE SOME POSSIBLE PROTECTION FROM LEGAL ACTION IF PATIENTS SIGN CONSENT FOR MATTERS USED. THANK YOU. EOM/CLS

POMID: 07143027
DATE: 91/05/03
TIME: 14:30:27
LIONAME: FAIRBANKS LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: MARY BOYD
TITLE:
ADDRESS: PO BOX 72666
CITY: FAIRBANKS ZIP: 99707
PHONE: 455-6265
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I SUPPORT THIS BILL. I WOULD LIKE INFORMED CONSENT ON WHAT HAPPENS IN MY MOUTH. DOCTORS AND PHARMACISTS ARE REQUIRED TO INFORM US OF THE DOWN SIDES OF THE THINGS THEY PRESCRIBE AND I THINK DENTISTS SHOULD TOO. I AM ONE OF THOSE PEOPLE THAT WAS POISONED BY MERCURY AMALGAM FILLINGS. I'M HAPPY NOW.
EOM/MJO

POMID: 07153236
DATE: 91/05/03
TIME: 15:32:36
LIONAME: FAIRBANKS LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: MARY COUTTS
TITLE:
ADDRESS: POB 45
CITY: ESTER ZIP: 99725
PHONE: 479-3645
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I REALLY AM IN SUPPORT OF YOUR PASSING THIS BILL. ITS A GOOD IDEA T
GIVE PEOPLE ALL THE INFORMATION POSSIBLE BEFORE THEY MAKE A DECISION. EOM/MW

POMID: 07165422
DATE: 91/05/03
TIME: 16:54:22
LIONAME: FAIRBANKS LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: DALTRICE D. BOEHMER
TITLE:
ADDRESS: 5911 DENALI ST,BLD A,APT 1
CITY: ANC ZIP: 99518
PHONE: 563-5782
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: THIS IS A VOICE OF SUPPORT FOR SB 123 . I'M HOPING THAT EACH OF YOU WILL CAREFULLY CONSIDER HOW IMPORTANT IT IS THAT EACH PERSON HAS THIS INFORMATION./ LW

POMID: 03113954
DATE: 91/05/06
TIME: 11:39:54
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: JOYCE KARCZMARCZYK
TITLE:
ADDRESS: P.O. BOX 752
CITY: DELTA JCT. ZIP: 99737
PHONE: 895-4340
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: IT IS IMPORTANT THAT WE BE INFORMED OF THE POSSIBLE EFFECTS MERCURY AMALGAM MAY HAVE ON US AND BE AWARE WE HAVE ALTERNATIVES TO AMALGAM. THEN WE CAN DECIDE FOR OURSELVES WHAT WE WANT TO USE.

POMID: 02105702
DATE: 91/05/09
TIME: 10:57:02
LIONAME: DELTA JUNCTION LIO

COPIES: SENATORS

SHULTZ
FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: CARMEN CARPENTER
TITLE:
ADDRESS: P.O. BOX 765
CITY: DELTA JCT. ZIP: 99737
PHONE: 895-4071
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: WE HAVE THE RIGHT TO BE INFORMED AND THE RIGHT TO DECIDE.

POMID: 02112542
DATE: 91/05/09
TIME: 11:25:42
LIONAME: DELTA JUNCTION LIO

COPIES: SENATORS

SHULTZ
FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: DR. CHARLES CONNELL
TITLE:
ADDRESS: 2702 GAMBELL ST.
CITY: ANC ZIP: 99503
PHONE: 279-7491
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I SUPPORT SEN. RODEY'S LEGISTATION ON CONSENT FOR DENTAL MATERIALS. HOWEVER, AFTER WORKING WITH PATIENTS INJURED BY DENTAL MATERIALS FOR THE PAST TWO AND A HALF YEARS, I DO NOT FEEL THAT IT GOES FAR ENOUGH. I THINK THAT THE SILVE R AMALGAM SHOULD BE LEGISLATED OUT OF EXISTENCE IN THIS STATE. I REALIZE THAT THIS MAY SEEM TO BE AN EXTREME VIEW, BUT THE CLINICAL EXPERIENCE OF THE PAST TWO AND A HALF YEARS HAS CAUSED RESULTS THAT CAUSE ME TO BE TERRIFIED./ L

POMID: 03140255
DATE: 91/04/15
TIME: 14:02:55
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: HEIDE GARRETT
TITLE:
ADDRESS: P.O.BOX 190988
CITY: ANCHORAGE ZIP: 99519
PHONE: 345-7205
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I SUPPORT SB 123. /BN

POMID: 03140417
DATE: 91/04/15
TIME: 14:04:17
LIONAME: ANCHORAGE LIO

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PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: RAND T. WALLS
TITLE:
ADDRESS: 8720 BLACKBERRY
CITY: ANCHORAGE ZIP: 99502
PHONE: 248-4047
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: AS A CONCERNED REGISTERED VOTER IN ALASKA, WE MUST INFORM THE PUBLIC OF ALL TOXIC SUBSTANCES IN THEIR LIVES. IN POINT, WHEN DENTIST PUT MERCURY IN THE MOUTHS OF OUR CHILDREN AND SODIUM FLORIDE IN THE WATER WE DRINK. I MUST VOICE MY CONCERNS FOR THE SAFETY OF OUR CHILDRENS FUTURE. /BN

POMID: 03120409
DATE: 91/04/15
TIME: 12:04:09
LIONAME: ANCHORAGE LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: ANN ANDERSON
TITLE:
ADDRESS: 2831 BENNETT AVENUE
CITY: ANCHORAGE ZIP: 99517
PHONE: 267-2342
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: VOTE YES ON SB 123. REMOVE FLUORIDE FROM ANCHORAGE WATER. /JSM

POMID: 03111142
DATE: 91/04/15
TIME: 11:11:42
LIONAME: ANCHORAGE LIO

COPIES:

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PUBLIC OPINION MESSAGE

BEAR: SENATOR STURGULEWSKI

NAME: ANITA HIGGINS
TITLE:
ADDRESS: 148 MICHAEL COURT
CITY: ANCHORAGE ZIP: 99504
PHONE: 338-0148
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I AM FOR SB 123. /JSM

POMID: 03113332
DATE: 91/04/15
TIME: 11:33:32
LIONAME: ANCHORAGE LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: WILLIAM SCHUITT
TITLE:
ADDRESS: 1510 CENTERVALE DRIVE
CITY: EAGLE RIVER ZIP: 99577
PHONE: 696-3383
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I AM IN SUPPORT OF SB 123. /JSM

(NOTE: THIS GENTLEMAN WAS ON A VOICE BOX AND WAS DIFFICULT TO UNDERSTAND. I AM NOT SURE THAT THE ADDRESS IS CORRECT - HOWEVER, THE PHONE NUMBER IS CONFIRMED SHOULD YOU NEED TO CONTACT HIM.)

POMID: 03100536
DATE: 91/04/15
TIME: 10:05:36
LIONAME: ANCHORAGE LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: PATSY HAYES
TITLE:
ADDRESS: 3331 E. HUFFMAN ROAD
CITY: ANCHORAGE ZIP: 99516
PHONE: 345-2772
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I SUPPORT SB 123. I BELIEVE DENTIST SHOULD ADVISE THEIR PATIENTS WHEN USING A TOXIC SUBSTANCE FOR FILLING MATERIAL AND ALSO INFORM THE PATIENT CONCERNING THE POTENTIAL COMPLICATIONS OF MERCURY AMALGAMS IN TEETH. /BN

POMID: 03142145
DATE: 91/04/18
TIME: 14:21:45
LIONAME: ANCHORAGE LIO

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SHARP	TAYLOR	ZHAROFF
ULMER	ZANACKI	

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: MR. GARY MCMICHEAL
TITLE:
ADDRESS: HC 01 BOX 6185-T
CITY: PALMER ZIP: 99645
PHONE: 745-8274
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I AM IN FULL SUPPORT OF THIS BILL.

POMID: 14122731
DATE: 91/04/16
TIME: 12:27:31
LIONAME: MAT-SU LIO

COPIES: SENATORS

FISCHER
COTTEN
HOFFMAN
MENARD

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: ROBERT J. ROWEN, M.D.
TITLE:
ADDRESS: 615 E. 82ND AVENUE,SUITE 300
CITY: ANCHORAGE ZIP: 99508
PHONE: 349-7775
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: PLEASE RALLY TO THE BASIC HUMAN RIGHTS OF ALASKANS TO BE INFORMED AS TO WHAT MATERIALS THEIR DENTISTS ARE IMPLANTING IN THEIR BODIES. SUPPORT SB 123. /CMR

POMID: 03114127
DATE: 91/04/19
TIME: 11:41:27
LIONAME: ANCHORAGE LIO

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RODEY
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UEHLING
ZHAROFF

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: CHRISTI A. VINCENT
TITLE:
ADDRESS: P.O. BOX 473, 1213 S. NORDIC DR.
CITY: PETERSBURG, AK. ZIP: 99833
PHONE: 772-9202
BILL NO: SB 123
SUBJECT: INFORMED CONSENT
MESSAGE: PLEASE SUPPORT SB 123. IT IS VERY IMPORTANT AND AFFECTS ALL OF US. I HAVE SUFFERED MANY HEALTH PROBLEMS BECAUSE OF THE MERCURY IN MY MOUTH AND WOULD LIKE TO SEE PEOPLE GIVEN A CHOICE AND TO BE INFORMED OF THE POSSIBILITIES OF HEALTH PROBLEMS WHEN CERTAIN MATERIALS ARE USED FOR FILLING TEETH.

POMID: 15161659
DATE: 91/02/28
TIME: 16:16:59
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NAME: MARIE MCENTIRE
TITLE:
ADDRESS: 6400 E. 15TH COURT
CITY: ANC ZIP: 99504
PHONE: 274-4741
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I WOULD LIKE TO SEE THIS PASSED. /LD

PCMID: 03085415
DATE: 91/03/19
TIME: 08:54:15
LIONAME: ANCHORAGE LIO

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FINKELSTEIN	FOSTER	FISCHER
GONZALES	GRUENBERG	FRANK
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HUDSON	IVAN	HOFFMAN
JACKO	KOPONEN	JONES
KUBINA	LARSON	KERTTULA
LEMAN	LINCOLN	MENARD
MACKIE	MACLEAN	PEARCE
MARTIN	M.A.MILLER	POURCHOT
M.H.MILLER	MOYER	RODEY
NAVARRE	PARNELL	SHULTZ
G.PHILLIPS	R.PHILLIPS	UEHLING
SHARP	TAYLOR	ZHAROFF
ULMER	ZAWACKI	

PUBLIC OPINION MESSAGE

DEAR: SENATOR STURGULEWSKI

NAME: DR. JOHN WALSH
TITLE:
ADDRESS: 550 WEST 7TH AVE, STE 1390
CITY: ANCHORAGE ZIP: 99501
PHONE: 258-1390
BILL NO: SB 123
SUBJECT: INFORMED CONSENT FOR DENTAL FILLINGS
MESSAGE: I URGE YOU TO PASS SB 123. /JSM

POMID: 03085846
DATE: 91/03/19
TIME: 08:58:46
LIONAME: ANCHORAGE LIO

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NAVARRE	PARNELL	SHULTZ
G.PHILLIPS	R.PHILLIPS	UEHLING
SHARP	TAYLOR	ZHAROFF
ULMER	ZANACKI	

11-22-91
12:12

To:
Sen. Stanguslewski
From:
Martha Reinbold

I was here this morning with
1) Dr. John Sparaga who is pres of local dental society
2) Dr. Richard Pauli
3) Dr. David Nelson
4) Dr. Gerald Stranik

These people may not be able to come this afternoon to testify.

In June
Phillip Moritz
Michael McKrill

over

In Fairbanks
Dr. Joseph Corning

could be others
coming in tho.

Estelle Ledbetter
430 E. 45th Ave
Anch, AK 99503

SB 123

12/2

Supports SB 123 - she has allergic reactions to amalgum. Wants to know of dangers. People should be notified of possible problems.

FROM HARVARD MEDICAL SCHOOL

Harvard Health Letter

VOLUME 16 • NUMBER 11 • SEPTEMBER 1991

DENTAL AMALGAM

Heavy Metal

Fatigue. High blood pressure. Mental and neurological illness. Dental amalgam — the most common material used for filling teeth — has been accused of causing a variety of woes. Some people worry that they should have their silver fillings removed and replaced with composite plastic or other materials (see the *HMS Health Letter*, November 1985).

Public concern about the risk of mercury in dental amalgam had declined somewhat in recent years, but it was inflamed once again by a controversial segment of CBS's program *60 Minutes* that ran last December, and by various newspaper and magazine articles. Behind the renewed coverage was a report from researchers at the University of Calgary implying that fillings placed in sheep's teeth released large

amounts of mercury that accumulated in various organs and in some animals allegedly caused severe kidney damage.

Fuzzy thinking?

The authors first announced their results in a press release, rather than following the usual route of publishing them in a scientific journal or presenting them at a professional meeting. The press release gave reporters access to these alarming claims before the work could be reviewed by other scientists.

These results are questionable for several reasons. To begin with, the amalgam placed in the sheeps' teeth contained far more mercury than a dentist would ever really use. This could have biased the researchers' findings in two ways. First, if too much mercury is present it can't bind properly with the other metals in the amalgam, permitting free mercury to be released in unusually large quantities. Second, improperly constituted fillings wear down easily, and the animals appear to have been ingesting considerable amounts of them.

On *60 Minutes*, videotapes of the experimenters at work showed them placing the fillings with poor technique, perhaps causing free mercury to linger on the amalgam surface. They also put in a dozen fillings at once — a blessedly uncommon practice in human dentistry.

Additionally, sheep may not be an accurate model for studying mercury exposure in humans. Although some of us clench our teeth in the night or in stressful situations, sheep are cud-chewers, and their flat teeth grind and wear nearly around the clock.

Thus it was not surprising that the researchers claimed to have found unusually high levels of mercury in the animals' bodies. What astonished experts was the claim that mercury exposure caused kidney failure in some of the animals, because the type of kidney damage reported was not the type that mercury is known to cause. This finding was also undermined by the fact that the researchers failed to take the next obvious step: if they thought mercury from amalgam caused kidney failure, they should have exposed other sheep to mercury alone to see if the problem recurred.

Results of some of the Calgary sheep studies have appeared in print. But concerned scientists say these papers are plagued by flaws that inflate estimates of mercury exposure. And the accounts ignore similar research carried out on dogs and humans during the 1950s, which generated very different results.

The bottom line is that findings from the Calgary studies give us no reason to revise earlier conclusions about the safety of dental amalgam in humans:

- Such fillings consist of mercury salts with no free metallic mercury.
- There is no credible evidence that any human illness or poisoning is caused by having amalgam fillings.
- This 100-year-old material is probably safer and more durable than the more modern alternatives.

Baah!

A trace amount of mercury vapor is present in the air we breathe out. This appears to come both from the lungs and from decomposition of the amalgam when its temperature rises by several hundred degrees. Drinking hot liquids or eating can't produce this increase. Grinding one's teeth can, but only for fractions of a second.

Since mercury is found in air, food, and water, people with fillings get about the same daily exposure from their teeth as people without fillings get from a combination of breathing, eating, and drinking tap water. People who spend a lot of time in high-mercury environments, including dentists, dental technicians, and factory workers who make thermometers or mercury-vapor lamps, have been extensively studied. They have shown no discernible health effects, even at exposures 100 times greater than those attributed to amalgam fillings.

People obsessed with the idea that amalgam is a health hazard have promoted their cause with faulty assumptions and flawed measurements. For their estimates of mercury exposure to be true, fillings would have to be vaporizing fast enough to disappear from people's mouths.

The only documented health problem associated with dental amalgam is an allergy to one of the metals — more often copper or silver than mercury. Although many people are allergic to nickel in jewelry, such difficulties with dental amalgam are exceedingly rare. Composite plastic fillings are actually more likely to spark allergic reactions.

Finally, what television didn't tell us: taking out a filling releases much more mercury than does putting one in or leaving it alone. A patient in the *60 Minutes* segment reported that her multiple sclerosis–like symptoms disappeared completely the day after her fillings were removed. However, such results indicate that her difficulties could not have been caused by dental amalgam, because levels had to be much higher the day she miraculously recovered than they were the day before her fillings were removed.

—ROBERT BARATZ, D.D.S., PH.D., M.D.

Dental "silver" tooth fillings: a source of mercury exposure revealed by whole-body image scan and tissue analysis

LESZEK J. HAHN, REINHARD KLOIBER, MURRAY J. VIMY,* YOSHIMI TAKAHASHI,† AND FRITZ L. LORSCHEIDER[1]

*Departments of Radiology, *Medicine, and †Medical Physiology, University of Calgary, Faculty of Medicine, Calgary, Alberta, T2N 4N1, Canada*

ABSTRACT

Mercury (Hg) vapor is released from dental "silver" tooth fillings into human mouth air after chewing, but its possible uptake routes and distribution among body tissues are unknown. This investigation demonstrates that when radioactive ^{203}Hg is mixed with dental Hg/silver fillings (amalgam) and placed in teeth of adult sheep, the isotope will appear in various organs and tissues within 29 days. Evidence of Hg uptake, as determined by whole-body scanning and measurement of isotope in specific tissues, revealed three uptake sites: lung, gastrointestinal, and jaw tissue absorption. Once absorbed, high concentrations of dental amalgam Hg rapidly localize in kidneys and liver. Results are discussed in view of potential health consequences from long-term exposure to Hg from this dental material. — HAHN, L. J.; KLOIBER, R.; VIMY, M. J.; TAKAHASHI, Y.; LORSCHEIDER, F. L. Dental "silver" tooth fillings: a source of mercury exposure revealed by whole-body image scan and tissue analysis. *FASEB J.* 3: 2641–2646; 1989.

Key Words: dental amalgam • mercury • tooth fillings • mercury vapor • mercury exposure

MERCURY (HG) HAS BEEN THE major component of tooth filling materials for the past 150 years (1) and its use has met with continuing controversy, as clear experimental evidence regarding its safety has not been demonstrated (2). Dental "silver" tooth fillings typically have a weight composition that is approximately 50% pure elemental Hg, 35% silver, 13% tin, 2% copper, and a trace amount of zinc when mixed as an amalgam (3). A newly placed multisurface dental silver filling involving an occlusal (grinding) surface of a molar tooth contains between 750–1000 mg of Hg and has an average serviceable life span in the human mouth of 7–9 years (4, 5). Approximately 80% of all tooth restorations employ this Hg/silver dental amalgam (6).

The traditional view in dentistry maintains that the Hg component of dental amalgam becomes inert once the fillings have been allowed to set for several days, and that long-term danger to the patient from Hg vapor is therefore remote (7). However, more recent clinical studies in subjects with amalgam fillings who chewed gum for 10 min have demonstrated that quite substantial amounts of Hg vapor are released into intra-oral air from dental amalgam, being sixfold higher than prechewing levels (8). The intra-oral Hg vapor concentration remained elevated during 30 min of continuous gum chewing; and after cessation of chewing, the mouth Hg vapor concentration declined slowly to prechewing levels over a period of 90 min (9). Control subjects with no amalgams had insignificant intra-oral air Hg vapor levels that did not change as a function of chewing (8). Brushing the teeth with commercial toothpaste will also stimulate the release of Hg vapor from amalgam surfaces (10). Although a positive correlation has been demonstrated between the number of dental amalgams and the levels of Hg vapor in the mouth (8, 9), it remains uncertain how much of this Hg is absorbed into body tissues. A current review, addressing whether Hg usage in dentistry constitutes a potential public health hazard, has concluded that further experimental evidence is needed, particularly regarding the metabolic fate of Hg vapor (2). The objective of this investigation was to determine possible sites of uptake and patterns of tissue distribution for Hg released from in situ dental amalgams. Qualitative information by whole-body scanning and quantitative tissue measurements by scintillation detection were determined using radioactive ^{203}Hg in a sheep experimental model.

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0892-6638/89/0003-2641/$01.50.

METHODS

In the present study a 4-year-old ewe that weighed 61 kg was anesthetized with halothane administered through an endotracheal tube fitted to a Narkovet-2 gas anesthetic machine. Dental surgery was performed with the preparation and placement of occlusal amalgam fillings according to standard procedure (11) into 12 molar teeth (3 molars on each side of the upper and lower jaws). This particular number of teeth was chosen because previous attempts to estimate the daily dose of Hg and body burden in humans had focused on subjects having 12 or more teeth with occlusal amalgam fillings (9, 12). The amalgam mass placed in each finished molar tooth of this ewe was approximately 850 mg, of which 50% was elemental Hg. **Figure 1** shows the placement of nonradioactive dental amalgam fillings in teeth of a sheep from a preliminary study with a lateral view of the skull (*A*), an occlusal view of amalgam restorations in the right lower jaw (*B*), and radiograph images of the upper and lower right jaws before (*C*) and after (*D*) amalgam placement. Before mixing the amalgam, 7.5 mCi of radioactive ^{203}Hg (New England Nuclear, Boston, Mass.), which had a specific activity of 12 mCi/g, was diluted 11-fold with nonradioactive Hg. At the conclusion of the dental surgery, the oral cavity was flushed with H_2O and rinsed several times by vacuum aspiration to remove any amalgam particle trimmings.

After surgery the ewe was provided free access to water and fed fresh hay twice daily for 29 days. During the course of the study intra-oral Hg vapor measurements were taken intermittently after chewing as previously described (8). On day 29, the animal was killed with sodium pentobarbital/saturated KCl. The tooth structure above the gum line containing the entire amalgam filling was individually sectioned and removed intact from each of the 12 molars to reduce the high background from ^{203}Hg remaining in the fillings. The animal was then imaged using a Technicare Omega-500 large-field-of-view gamma camera equipped with a medium energy collimator (13, 14). An image of the sheep was obtained in the right lateral projection, using the 279 ± 28 KeV gamma rays of ^{203}Hg. In addition, transmission images were obtained using a flat 30-cm diameter ^{57}Co source that outlined the contour of the sheep's body. A posterior projection image was repeated after removal of the gastrointestinal tract. Tissue and fluid specimens were weighed at autopsy and analyzed for radioactivity. Isotope measurements were taken for

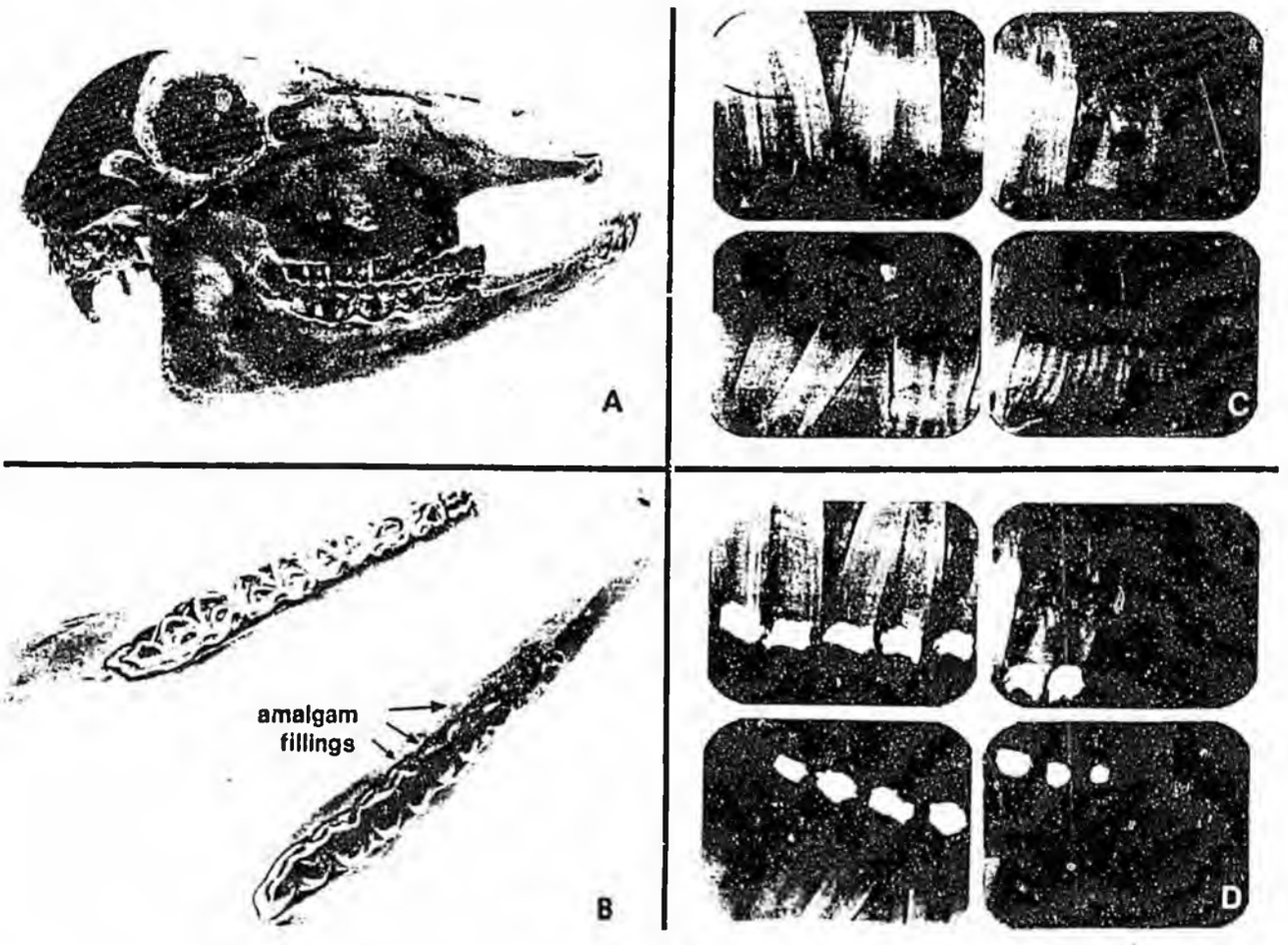

Figure 1. Placement of dental amalgam fillings in sheep teeth: *A*) lateral view of sheep skull; *B*) occlusal view of sheep mandible showing occlusal amalgam restorations in the mandibular right quadrant; *C*) periapical radiographs of the upper and lower right quadrants before amalgam placement; *D*) periapical radiographs of the upper and lower right quadrants after amalgam placement. The x-ray views indicate that anchorage of these fillings has been achieved with appropriate undercuts.

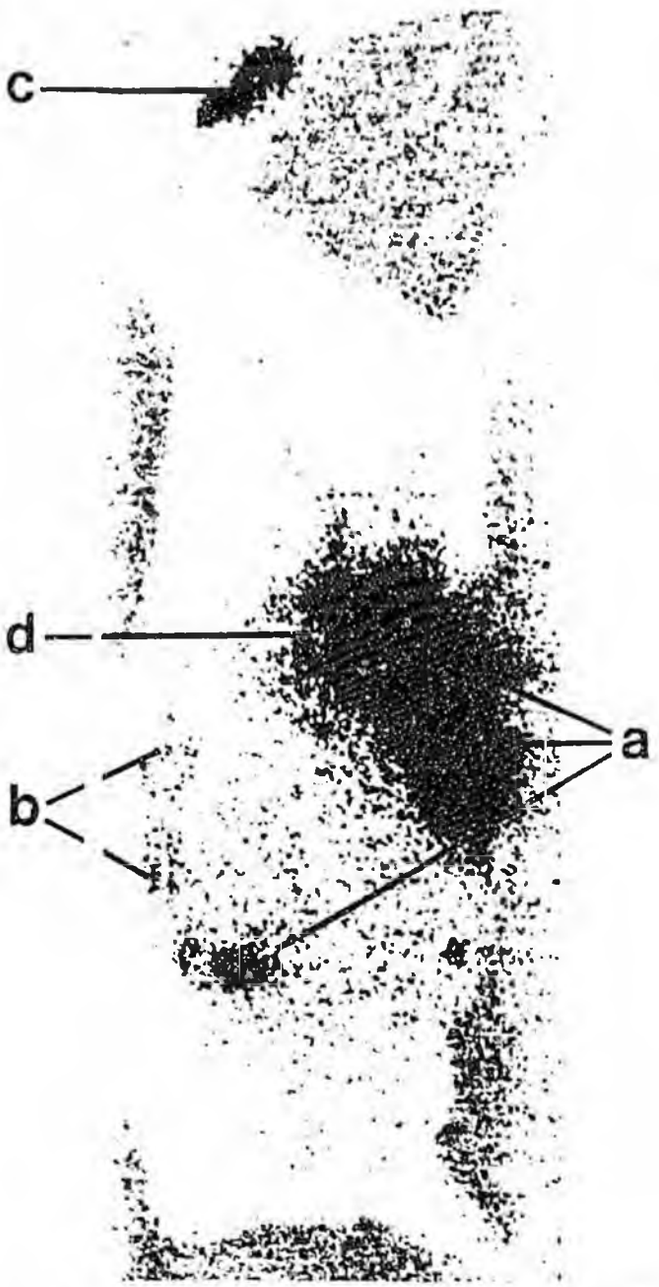

Figure 2. Right lateral image of amalgam ^{203}Hg distribution in the intact sheep, after removal of the dental amalgams, with superimposed transmission scan showing the body contour. The greatest concentrations of ^{203}Hg are in the gastrointestinal tract (*a*), kidneys (*b*), and in the gum and alveolar bone of the jaws (*c*). Liver activity (*d*) is obscured by large quantities of Hg in the gut on this image.

10 min per specimen (approximately 2% SD counting error) or 100 min per specimen for tissues with low counts (<10% SD counting error) in a Picker gamma well-counter calibrated to an energy range window of 249–309 KeV. Background counts +15% were set automatically for subtraction after a blank reading was taken for 100 min. This instrument subtraction level was sufficiently high so that no net counts were detectable during a repeat 100-min background measurement. At an 80% instrument counting efficiency, 1 μCi equals 1,776,000 cpm. Data, initially expressed as net radioactive cpm, were corrected for the physical half-life (47 days) of ^{203}Hg decayed to 29 days (65% remaining), for the specific activity of ^{203}Hg (83,300 ng/μCi), and for the dilution of ^{203}Hg with nonradioactive Hg (11-fold). The final calculation represented the total amalgam Hg (ng) per g (wet wt) of tissue or fluid as follows: (cpm/65%) × (83,300 ng/μCi × 11)/1,776,000 cpm/μCi/g.

RESULTS

Figure 2 demonstrates the ^{203}Hg distribution from amalgam within the body of the sheep as viewed from the right side. The transmission image obtained without moving the animal is superimposed to facilitate orientation. Primary sites of Hg concentration are in the abdominal cavity, specifically in the gastrointestinal tract, liver, and kidneys. A second major site is in the upper and lower jaws, even though the tooth structure containing the radioactive amalgam has been removed in its entirety.

Figure 3 is the posterior image of ^{203}Hg distribution from amalgam in the sheep's abdomen after removal of the gastrointestinal tract. The left kidney is clearly identified. The larger area of activity on the right side of the animal represents the liver and the right kidney, from which some tissue had been removed for well-counting.

Table 1 lists the total concentration of amalgam Hg in various tissues at autopsy 29 days after placement of dental amalgam fillings. Whole blood and urine contained 9.0 and 4.7 ng Hg/g, respectively. Muscle concentration of Hg was similar to blood, but concentration in fat remained low. In the oral/nasal tissues, Hg was concentrated primarily in gum mucosa (323 ng/g) and tooth alveolar bone (318 ng/g). In the gastrointestinal tract the washed stomach lining (929 ng/g) and

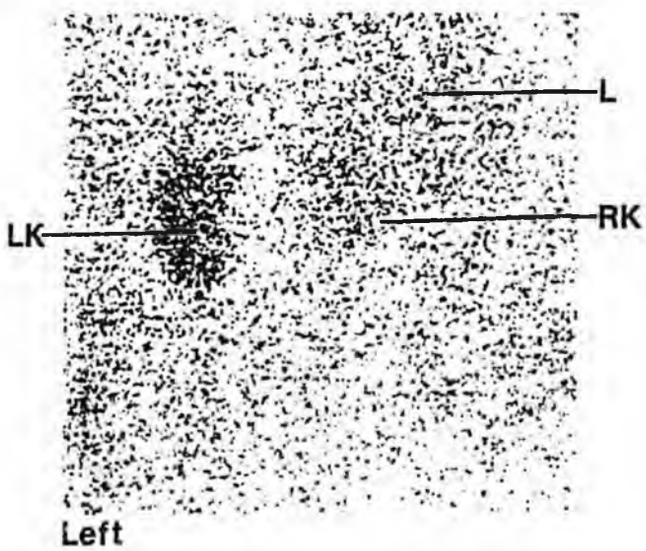

Figure 3. Posterior image of amalgam ^{203}Hg distribution in the abdomen after removal of the gastrointestinal tract which demonstrates Hg within the kidneys and liver. The left kidney (LK) is clearly identified. The large area of Hg deposition on the right side of the animal represents a combination of liver (L) and right kidney (RK). Some tissue had been removed from the right kidney, which had been mobilized and placed further from the detector, explaining the lower intensity compared with the left.

TABLE 1. *Concentration of amalgam Hg in sheep tissues 29 days after placement of dental amalgam fillings*

Tissue	ng Hg/g
Whole blood	9.0
Urine	4.7
Skeletal muscle (gluteus)	10.1
Fat (mesentery)	0.9
Cortical maxillary bone	3.6
Tooth alveolar bone	318.2
Gum mucosa	323.7
Mouth papilla	19.7
Tongue	13.0
Parotid gland	7.8
Ethmoturbinal (nasal) bone	10.7
Stomach	929.0
Small intestine	28.0
Large intestine	63.1
Colon	43.1
Bile	19.3
Feces	4489.3
Heart muscle (ventricle)	13.1
Lung	30.8
Tracheal lining	121.8
Kidney	7438.0
Liver	772.1
Spleen	48.3
Frontal cortex	18.9
Occipital cortex	3.5
Thalamus	14.9
Cerebrospinal fluid	2.3
Pituitary gland	44.4
Thyroid	44.2
Adrenal	37.8
Pancreas	45.7
Ovary	26.7

feces (4489 ng/g) contained the most Hg, although Hg concentration in other washed intestinal tract tissues was three- to sixfold higher than in blood, and bile concentration was more than twice that of blood. Heart muscle contained Hg levels that were similar to skeletal muscle. However, lung concentration of Hg (30 ng/g) was threefold higher than blood, and tracheal lining was much higher at 121 ng/g. Abdominal organs demonstrating the greatest concentration of Hg were kidney (7438 ng/g) and liver (772 ng/g). Spleen contained 48 ng Hg/g, which was fivefold higher than blood content. In the central nervous system the brain frontal cortex and thalamus concentrations of Hg were higher than in either blood or cerebrospinal fluid. Endocrine gland concentrations of Hg were three- to fivefold higher than blood. There is not a direct correlation between the intensity of Hg-203 localization on the whole-body scan and absolute radioactivity counts in autopsied tissues because of attenuation and geometry factors that affect the image.

DISCUSSION

The results of this study clearly demonstrate that substantial quantities of Hg from amalgam will appear in various body tissues as early as 29 days after placement of amalgam fillings in teeth. This Hg can be readily visualized by scintigraphy and can be easily quantified by analysis of tissue radioactivity. The experimental design of this in vivo isotope study has the advantage that all of the Hg measured originates only from dental amalgam and cannot be attributed to food, water, or background environmental sources.

Our findings indicate at least three principal sites for absorption of Hg from amalgam. First, the lungs absorbed Hg as did the cilia lining the trachea because of continual breathing of intra-oral air that had a Hg vapor concentration ranging from 19–50 $\mu g/m^3$ throughout this study. In humans, approximately 80% of inhaled elemental Hg vapor is absorbed into blood and becomes available for tissue retention (15). Second, the gastrointestinal tract contained a large amount of Hg likely due to mixing of intra-oral Hg vapor, amalgam microparticles, and dissolved mercuric ions with saliva and food before swallowing. About 10% of the elemental Hg in the human gastrointestinal tract can be absorbed into blood (16). Even though the efficiency of Hg absorption in the gut is low, large amounts of Hg in feces seen in the present study may signify a substantial pathway for uptake of Hg in its elemental or vapor forms. Amalgam microparticles containing Hg would not likely be susceptible to gut absorption. Third, some tissues in the jaw such as gum mucosa and the tooth root and surrounding bone also absorbed Hg. The Hg absorbed into the jaw could be transported from bone marrow directly into blood by venous routes radiographically demonstrated for human circulation (17). The highly vascularized oral mucosa may likewise afford a route for some Hg vapor transport directly into the systemic circulation.

We are confident that the Hg uptake observed in this animal was not the result of procedural contamination during dental surgery because serial blood measurements taken for 24 h after surgery had no measurable radioactivity. This indicates that the endotracheal tube prevented inhalation of Hg vapor. Any amalgam particles not removed from the mouth by surgical rinsing would have passed through the gastrointestinal tract well before 29 days when the imaging was performed.

After the Hg released from dental amalgam is absorbed into blood, the two principal target organs of rapid accumulation are kidney and liver. Based on organ weights for kidneys (250 g) and liver (1000 g) in the adult ewe, the total Hg concentrated in the kidney in this animal was 1.86 mg, and in the liver it was 0.77 mg, after only 29 days. Even during this relatively short time, the brain and several endocrine glands (pituitary, thyroid, adrenal, pancreas, and ovary) also showed evidence of Hg accumulation from the dental amalgams.

Since Hg/silver fillings remain in human teeth for 8–10 years, this would allow an extended opportunity for body tissues to be continuously exposed to Hg. Other investigators have recently reported that Hg concentrations in autopsied human brain and kidney are significantly higher in those subjects with dental amalgams than in subjects with no amalgams (18).

Each molar tooth of this sheep contained approximately 425 mg Hg, only one-half the amount of Hg used in the average human occlusally involved molar filling. In humans, occlusally involved Hg/silver dental fillings frequently encompass additional tooth surfaces such as buccal, lingual, mesial, and distal aspects. Thus, such complex human tooth restorations have a greater surface area exposed to grinding forces from which Hg may vaporize. This is in contrast to occlusal restorations in this sheep that are limited only to the occlusal surface and are totally supported circumferentially by solid tooth structure. The natural ovine molar is multiridged for forage grinding. Technical reproduction of these ridges to their original exact functional occlusal level in the amalgam fillings was not possible. Therefore, the restorations were purposely overcarved, which created a concave occlusal surface, ensuring that the amalgams would not be functionally too high and thus subject to abnormally rapid wear. None of the Hg/silver fillings were lost from the mouth during the course of this study.

We believe the sheep is a suitable experimental model for the purpose of our investigations because it exhibits molar chewing mechanics that are similar to those of humans. Moreover, intra-oral air Hg vapor levels in the sheep are very similar to those reported in humans with the same number of amalgams (9). Although sheep may chew more than the average human does, it is likely that humans who are chronic gum chewers or who exhibit bruxism (chronic grinding of teeth) would have daily periods of chewing that are comparable to sheep fed two meals per day. The sheep body weight also compares favorably with humans, and the sheep is the most widely used obstetrical model in research today.

In other studies of sheep that were not imaged (19), we have established that Hg vaporized from dental amalgam fillings will progressively accumulate in both maternal and fetal tissues as a function of time, and tissue Hg levels will remain elevated in experiments run for as long as 140 days. Exposure of newborn lambs to milk suckled from ewes with dental amalgams results in Hg uptake into tissues of the young.

In North America 5.4% of the population display contact hypersensitivity to Hg (20). The pathogenesis of a variety of immediate or delayed Hg-induced hypersensitivity responses by the immune system resulting in glomerulonephritis has been postulated (21). Experimental evidence supports this contention because Hg is capable of inducing autoreactive T lymphocytes and specific autoantibodies resulting in Hg-induced autoimmunity (22, 23), indicating a potential for Hg to precipitate antibody-mediated tissue injury and autoimmune disease. The kidney and endocrine glands are known sites of autoimmune disorders, which brings into question the long-term implications of Hg concentration in these tissues from dental amalgams as demonstrated by the present study.

Our laboratory findings in this investigation are at variance with the anecdotal opinion of the dental profession, which claims that amalgam tooth fillings are safe. Experimental evidence in support of amalgam safety is at best tenuous (2). From our results we conclude that dental amalgams can be a major source of chronic Hg exposure. As it has been estimated that in North America 100,000 kg of Hg are used each year in dentistry (7), continuing research in this area is essential and may have an effect on public health. [F1]

The authors thank J. E. Fewell, Director of the Reproductive Medicine Research Group, and the Christie Unit for the Study of Human Reproduction, for providing facilities and assistance with materials to conduct this investigation. Nuclear medicine facilities were kindly supplied by the Foothills Provincial Hospital Department of Nuclear Medicine, Calgary. Partial support was provided by a grant from the International Academy of Oral Medicine and Toxicology. The authors are also grateful to S. Naatz and M. Satchwell for their assistance with the dental surgery, S. Kelly for assistance with animal management, and C. McKay and K. Wise for assistance with the nuclear medicine imaging procedures.

REFERENCES

1. American Academy of Dental Science (1876) *History of Dental and Oral Science in America*, Samuel S. White Publ., Philadelphia
2. Enwonwu, C. O. (1987) Potential health hazard of the use of mercury in dentistry: critical review of the literature. *Environ. Res.* **42**, 257–274
3. Skinner, E. W., and Phillips, R. W. (1969) Dental amalgam alloys. Metallography of amalgam. (Chapt. 20, p. 303); Dental amalgam: technical considerations (Chapt. 22, p. 332) In *The Science of Dental Materials*, 6th Ed. W. B. Saunders Co., Philadelphia
4. Paterson, N. (1984) The longevity of restorations. *Br. Dent. J.* **157**, 23–25
5. Phillips, R. W., Hamilton, A. I., Jendresen, M. D., McHorris, W. H., and Schallhorn, R. G. (1986) Report of committee on scientific investigation of the American Academy of Restorative Dentistry. *J. Prosthet. Dent.* **55**, 736–772
6. Bauer, J. G., and First, H. A. (1982) The toxicity of mercury in dental amalgam. *Calif. Dent. Assoc. J.* **10**, 47–61
7. Rupp, N. W., and Paffenbarger, G. O. (1971) Significance to health of mercury used in dentistry: a review. *J. Am. Dent. Assoc.* **82**, 1401–1407
8. Vimy, M. J., and Lorscheider, F. L. (1985) Intra-oral air mercury released from dental amalgam. *J. Dent. Res.* **64**, 1069–1071
9. Vimy, M. J., and Lorscheider, F. L. (1985) Serial measurements of intra-oral air mercury: estimation of daily dose from dental amalgam. *J. Dent. Res.* **64**, 1072–1075
10. Patterson, J. E., Weissberg, B., and Dennison, P. J. (1985) Mercury in human breath from dental amalgam. *Bull. Environ. Contam. Toxicol.* **34**, 459–468
11. Hampson, E. L. (1980) Amalgam restorations. In *Textbook of Operative Dentistry*, 4th Ed., pp. 39–63, Wm. Heineman Medical Books Ltd., London
12. Vimy, M. J., Luft, A. J., and Lorscheider, F. L. (1986) Estimation of mercury body burden from dental amalgam: computer simulation of a metabolic compartmental model. *J. Dent. Res.* **65**, 1415–1419
13. Anger, H. O. (1967) Radioisotope cameras. In *Instrumentation in Nuclear Medicine* (Hine, G. J., ed) Vol. I, pp. 485–552, Academic Press, New York

14. Sorenson, J. A., and Phelps, M. E. (1987) The Anger camera: basic principles. In *Physics in Nuclear Medicine*, 2nd Ed., pp. 298–317, Grune & Stratton Inc., Orlando, Florida
15. Nielsen-Kudsk, F. (1965) Absorption of mercury vapor from the respiratory tract in man. *Acta Pharmacol. Toxicol.* **23**, 250–262
16. Task Group on Metal Accumulation (1973) Accumulation of toxic metals with specific reference to their absorption, excretion and biological half-times. *Environ. Physiol. Biochem.* **3**, 65–107
17. Stortebecker, P. (1967) Dental significance of pathways for dissemination from infectious foci. *J. Can. Dent. Assoc.* **33**, 301–311
18. Nylander, M., Friberg, L., and Lind, B. (1987) Mercury concentrations in the human brain and kidneys in relation to exposure from dental amalgam fillings. *Swed. Dent. J.* **11**, 179–187
19. Vimy, M. J., Takahashi, Y., and Lorscheider, F. L. (1990) Maternal-fetal distribution of mercury (^{203}Hg) released from dental amalgam fillings. *Am. J. Physiol.* In press.
20. North American Contact Dermatitis Group (1973) Epidemiology of contact dermatitis in North America: 1972. *Arch. Dermatol.* **108**, 537–540
21. Druet, P., Bernard, A., Hirsch, F., Weening, J. J., Gengoux, P., Mahieu, P., and Berkeland, S. (1982) Immunologically mediated glomerulonephritis induced by heavy metals. *Arch. Toxicol.* **50**, 187–194
22. Hirsch, F., Kuhn, J., Ventura, M., Vial, M-C., Fournie, G., and Druet, P. (1986) Autoimmunity induced by $HgCl_2$ in Brown-Norway rats. I. Production of monoclonal antibodies. *J. Immunol.* **136**, 3272–3276
23. Pelletier, L., Pasquier, R., Hirsch, F., Sapin, C., and Druet, P. (1986) Autoreactive T cells in mercury-induced autoimmune disease: in vitro demonstration. *J. Immunol.* **137**, 2548–2554

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Whole-body imaging of the distribution of mercury released from dental fillings into monkey tissues

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Abstract The fate of mercury (Hg) released from dental "silver" amalgam tooth fillings into human mouth air is uncertain. A previous report about sheep revealed uptake routes and distribution of amalgam Hg among body tissues. The present investigation demonstrates the bodily distribution of amalgam Hg in a monkey whose dentition, diet, feeding regimen, and chewing pattern closely resemble those of humans. When amalgam fillings, which normally contain 50% Hg, are made with a tracer of radioactive ^{203}Hg and then placed into monkey teeth, the isotope appears in high concentration in various organs and tissues within 4 wk. Whole-body images of the monkey revealed that the highest levels of Hg were located in the kidney, gastrointestinal tract, and jaw. The dental profession's advocacy of silver amalgam as a stable tooth restorative material is not supported by these findings. — HAHN, L. J.; KLOIBER, R.; LEININGER, R. W.; VIMY, M. J.; LORSCHEIDER, F. L. Whole-body imaging of the distribution of mercury released from dental fillings into monkey tissues. *FASEB J.* 4: 3256–3260; 1990.

Key Words: dental amalgam • mercury • tooth fillings • mercury vapor • mercury exposure

DENTAL "SILVER" AMALGAM TOOTH FILLINGS, which normally contain 50% mercury (Hg) metal by weight, release Hg vapor into human mouth air as a result of chewing (1–3) or tooth brushing (4). Levels of Hg vapor in intraoral air correlate significantly with the number of amalgam fillings (2, 3), and these Hg vapor levels remain elevated during prolonged chewing, declining slowly to basal levels 90 min after chewing ceases (3).

Estimations of the amount of amalgam Hg absorbed daily in humans vary from 1.2 to 27 μg Hg/day, with an average of approximately 10 μg/day; and individual subjects can receive daily doses of as much as tenfold higher than this average (5). Human autopsy studies demonstrate significantly higher Hg levels in the brain and kidney of adult subjects with aged dental amalgams than in control subjects with no amalgams (6). It is believed that dental amalgams constitute the major source of exposure to inorganic Hg in the general population (7).

Recently we used an experimental animal model in which sheep received dental amalgam fillings containing a radioactive Hg tracer. One study demonstrated, by whole-body imaging, that the sites of amalgam Hg uptake in sheep include oral tissues, jaw bone, lung, and gastrointestinal tract, with a subsequent high concentration of Hg in the kidney and liver (8). Another study, which used pregnant sheep, showed that both maternal and fetal tissues begin to accumulate Hg within several days after amalgam placement, and that this accumulation progressed along with gestation (9). It is unknown whether the frequency of eating, molar chewing pattern, or type of food influenced the degree to which Hg was released from sheep dental amalgams, or if the results were directly comparable to humans. Therefore the objective of the present investigation was to determine the bodily distribution of amalgam Hg in a primate species whose dentition is similar to that of humans, and whose diet, frequency of feeding, and chewing pattern closely resemble those of humans.

METHODS

A wild-caught male cynomolgus monkey (*Macaca fascicularis*), approximately 7 years old and weighing 5 kg, was obtained from Charles River Canada Inc. (St. Constant, Quebec, Canada). The animal was singly housed in a large squeeze-back cage and acclimated to its environment and diet for 2 wk before surgery. Twice daily the animal was fed Wayne 25% Primate Diet (no.

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8663, Teklad/Premier Laboratory Diets, Madison, Wis.) supplemented with apples, oranges, bananas, sunflower seeds, and peanuts. Fresh water was available ad libitum. Before dental surgery the monkey was fasted for 24 h and water was withheld for 12 h. Anesthesia was induced with an intramuscular injection of ketamine hydrochloride-xylazine mixture (Ketaset, 11 mg/kg, Austin Laboratories Canada Ltd., Joliette, Quebec, Canada; Rompun, 1.1 mg/kg, Haver/Chemagro Ltd., Etobicoke, Ontario, Canada). A 5.5-mm o.d. endotracheal tube (Portex Inc., Wilmington, Mass.) was inserted, and unassisted general anesthesia was maintained with a Narkovet 2 anesthetic machine (N. American Drager, Telford, Pa.) delivering a gas mixture of 0.6 l/min nitrous oxide, 0.4 l/min oxygen, and halothane (0.5–0.8%, MTC Pharmaceuticals, Cambridge, Ontario, Canada).

The preparation and placement of dental amalgam fillings was as previously described for sheep (8), with several modifications. Before the study, stone gypsum models of adult monkey teeth were constructed from alginate impressions of the maxilla and mandible of a monkey skull. Occlusal amalgam fillings were placed in the stone models, trimmed, and finished in three maxillary and three mandibular molar teeth, and then the fillings were removed and weighed. The average mass of these fillings (180 mg each) was used to determine the minimum amount of nonradioactive Hg needed to dilute the isotopic Hg and be sufficient to fill 16 teeth. Before mixing the amalgam, 15.5 mCi of radioactive ^{203}Hg metal with a specific activity of 17.37 mCi/g (Amersham Canada, Oakville, Ontario, Canada) was diluted 2.5-fold with nonradioactive Hg to a lower specific activity of 6.91 mCi/g.

At surgery, occlusal amalgam fillings were prepared (8) and inserted into 16 teeth (3 molars and the adjacent second premolar in each quadrant of the upper and lower jaws). After amalgam placement, an average occlusal amalgam mass of 186 mg/tooth (93 mg Hg/tooth) was estimated by correcting for both the remaining unused Hg and an estimated 25% amalgam loss during placement and carving. The total Hg in the monkey teeth (1488 mg) was labeled with 10.3 mCi ^{203}Hg. The amalgam fillings were limited to the occlusal surface; they were completely supported circumferentially by solid tooth structure, and were slightly overcarved to create a concave surface that would not be subject to abnormally rapid wear. At the conclusion of dental surgery, the oral cavity was flushed thoroughly several times with a water rinse that was removed by vacuum aspiration to clean the mouth of amalgam particle trimmings.

On day 28 after amalgam placement, the monkey was again anesthetized with ketamine alone (13 mg/kg) and then killed with an i.v. injection of sodium pentobarbital (Euthanyl, MTC Pharmaceuticals). Blood, cerebrospinal fluid, and urine specimens were taken for Hg analysis. Each of the 16 teeth containing amalgam fillings was individually sectioned in the horizontal plane immediately above the gingival margin, and the clinical crown was removed intact with the amalgam to reduce the high background from the ^{203}Hg. The animal was taped in the ventral position to a rigid cardboard support and imaged with a large field-of-view gamma camera to localize ^{203}Hg by planar scintigraphy as described for sheep (8), with several modifications. The ADAC GENESYS single photon emission computerized tomography and total body digital imaging system (ADAC Laboratories, Milpitas, Calif.) was used. Three imaging scans were obtained: one in the anterior (ventral), and two in the posterior (dorsal) projections before and after removal of the entire gastrointestinal tract. The data were acquired using the pulse height analyzer (PHA)[2] peaked at 279 ± 28 keV. To outline the body contour of the monkey in each projection, transmission images were obtained with a flat 30-cm diameter ^{57}Co source using a PHA setting of 122 ± 12 keV.

Tissue and fluid specimen weights obtained at autopsy were used in conjunction with radioactivity measurements to determine total Hg concentrations as described previously (8), with several modifications. A Canberra Nuclear Products Group (Canberra Industries, Meriden, Conn.) well-counter system was used with a SpecMate NaI preamplifier/amplifier, an Accuspec acquisition interface board, and a Bicron 2" NaI (Tl) scintillation detector operating on MS-DOS 3.3 based software supplied by the manufacturer for IBM PC XT/AT,386,PS/2 computers. This system counted ^{203}Hg with a 25% instrument detection efficiency, its multichannel analyzer was peaked to accept a 279 keV ± 10% energy range, and a stable low background count was subtracted from each tissue measurement. In this scintillation detection configuration 1 μCi equals 555,000 cpm, at 28 days of physical decay for ^{203}Hg approximately 66% of the isotope remains, and after a 2.5-fold dilution with nonradioactive Hg, the specific activity of ^{203}Hg in amalgam was 144,000 ng/μCi. Total amalgam Hg in tissue (ng Hg/g wet wt) was calculated by the equation: (cpm/66%) × (144,000 ng/μCi)/555,000 cpm/μCi/g.

RESULTS

Figure 1 demonstrates the bodily distribution of ^{203}Hg released from dental amalgam tooth fillings 28 days after placement as viewed from both ventral and dorsal imaging positions. The transmission image, obtained without moving the animal from each position, is superimposed to outline the body contour. Figure 1*A* is the ventral whole-body image projection, revealing that the primary sites of Hg concentration are kidney, gastrointestinal tract, and jaw. Figure 1*B* is a dorsal whole-body image projection revealing the same three sites of Hg concentration. The apparent lower activity of ^{203}Hg, particularly in the jaw, reflects the increased tissue attenuation between the gamma camera and the radioisotope locus in this projection. Figure 1*C* is the dorsal whole-body image projection after removal of

[2]Abbreviation: PHA, pulse height analyzer.

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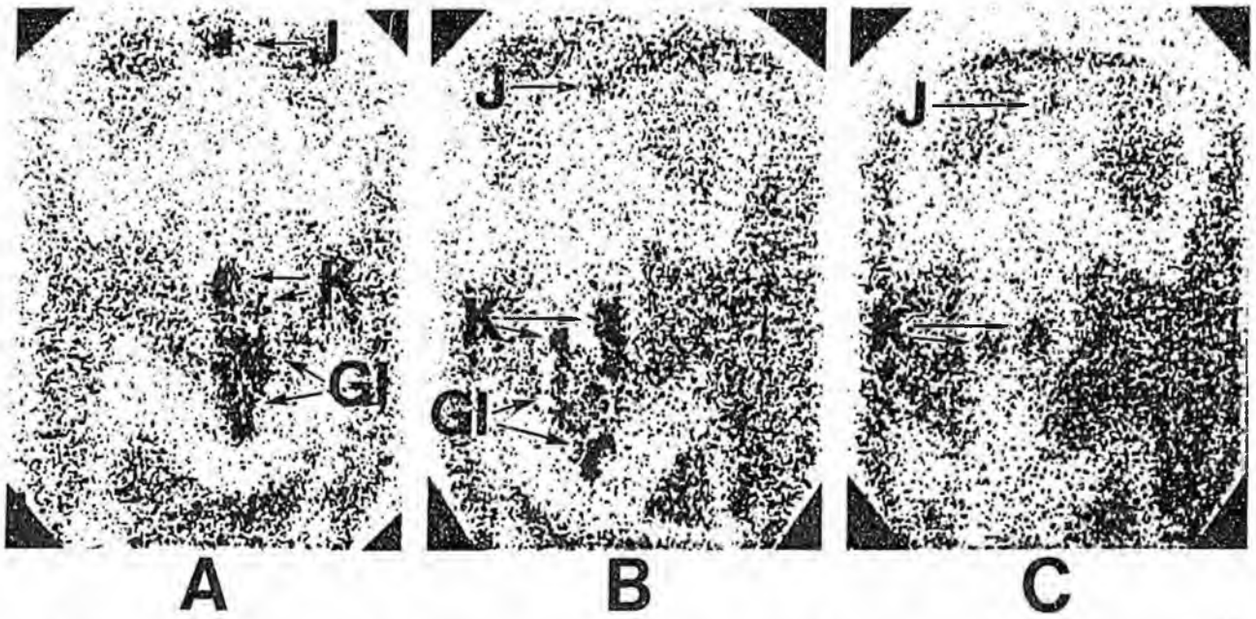

Figure 1. Whole-body image scan of amalgam ^{203}Hg localization in a 7-year-old male monkey (*M. fascicularis*) after removal of dental amalgams. A superimposed transmission scan with a ^{57}Co source outlines the body contour. *A*) Ventral image; *B*) dorsal image; *C*) dorsal image after removal of the gastrointestinal tract. J, jaw; K, kidneys; GI, gastrointestinal tract.

the entire gastrointestinal tract. The kidneys and jaw remain visible.

Table 1 lists the total concentration of amalgam Hg in various tissues obtained at autopsy 28 days after amalgam placement. Whole blood and urine contained 5.8 and 17.7 ng Hg/g, respectively. Synovial membrane had concentrated 31.6 ng/g, but Hg in skeletal muscle was very low and was not detected in fat. In oral tissues, Hg was concentrated primarily in tooth alveolar bone (7756 ng/g), gingivae adjacent to the amalgam fillings (4190 ng/g), and the tongue region in opposition to the filled teeth (253 ng/g). In the gastrointestinal tract, washed linings of the large intestine (983 ng/g) and colon (482 ng/g) contained the highest concentrations of Hg. Bile concentration of Hg (243 ng/g) was 40-fold higher than Hg concentration in blood. Feces contained 3490 ng Hg/g. Heart muscle levels of Hg were similar to that of blood, but Hg concentration in the lung was threefold higher than in blood, and in the trachea it was twofold higher. The abdominal organ with the highest concentration of Hg was the kidney (3053 ng/g). Liver, at 133 ng/g, had more than 20-fold the Hg levels found in blood. In the nervous system, all three regions of the brain concentrated Hg at levels greater than either blood or cerebrospinal fluid. However, no Hg was detected in either the spinal cord or sciatic nerve. Endocrine gland concentrations of Hg were highest for the pituitary (83 ng/g) and for other glands, except the thyroid, they were two- to fivefold higher than that of blood.

TABLE 1. *Concentration of amalgam Hg in monkey tissues 28 days after placement of dental amalgam tooth fillings*

Tissue	ng Hg/g
Whole blood	5.8
Urine	17.7
Synovial membrane (knee joint)	31.6
Skeletal muscle (gluteus)	1.9
Fat (mesentery)	0.0
Tooth alveolar bone	7756.1
Oral mucosa	86.6
Gingivae	4190.4
Tongue	253.3
Parotid gland	1.6
Stomach	18.4
Small intestine	68.9
Large intestine	983.1
Colon	482.7
Bile	243.1
Feces	3490.2
Heart (ventricle)	6.6
Lung	15.0
Trachea	12.6
Kidney	3053.5
Liver	133.1
Spleen	15.6
Frontal cortex	7.2
Occipital cortex	12.6
Thalamus	9.9
Sciatic nerve	0.0
Spinal cord	0.0
Cerebrospinal fluid	1.9
Pituitary	83.6
Thyroid	4.1
Adrenal	31.3
Pancreas	15.6
Testes	12.7

DISCUSSION

This study clearly demonstrates that the phenomenon of high Hg accumulation in body tissues after dental amalgam placement which we previously reported in sheep

(8, 9) is not unique to that species, and is readily demonstrable in primates as well. The dentition, chewing pattern, and diet of this monkey were similar to that of humans. The surgical procedure and the use of isotopic Hg ensured that the only Hg detected was that which escaped from the amalgam tooth fillings during the 4-wk period after dental surgery. The routes of absorption of amalgam Hg and the potential significance of this phenomenon to dental and medical physiology have been discussed in detail in our earlier report on sheep (8).

Each amalgam tooth restoration in the monkey contained only 93 mg Hg, which compares with an average of 425 mg Hg/tooth in sheep (8). All 16 amalgam fillings remained intact for the duration of the present study.

A substantial amount of Hg was transported from dental amalgam to adjacent oral tissues, and is visualized in the monkey. This finding is consistent with earlier reports of other methods in humans which have demonstrated that Hg ions migrate from amalgam into gingivae (10), dentin (11, 12), dental pulp (13), tooth roots, and surrounding alveolar bone (14).

Concentration of Hg in the kidney of this monkey (3053 ng/g) contrasted to that in sheep kidney (7438 ng/g) (8). Such differences may reflect frequency and patterns of chewing in these species. Coincident with the present study, another laboratory reports that after prolonged exposure (1 year) to amalgam Hg, monkeys that had only eight nonradioactive occlusal amalgam fillings (containing one-third the total Hg used in the present study) will have kidney levels of Hg averaging 3900 ng/g tissue with dense Hg accumulations located in proximal tubule cells (15). As this is approximately 30% higher Hg concentration than we have observed in the primate kidney 4 wk after placement of twice the number of such fillings, this suggests that with longer duration of exposure to amalgam Hg the kidney will concentrate increasingly larger amounts of Hg. Moreover, the locus of Hg accumulation in the proximal tubule, which is the primary site of sodium reabsorption, would explain why such reabsorption is markedly impaired in animals after placement of dental amalgams (16). The significance of amalgam Hg accumulation in kidney on parameters of renal function will be communicated in full detail in another report.

Similarly, fecal Hg concentration was 3490 ng/g in monkey compared with 4489 ng/g in sheep (8). Fecal excretion of Hg in sheep was evident within 3 days after amalgam placement, and continued throughout a 140-day study (9); a similar Hg excretion pattern was observed in the monkey for the duration of this experiment. Full details of the effects of amalgam Hg excretion patterns on the populations and functions of bacterial species in the intestinal tract and on gingival surfaces will be reported elsewhere.

Now that it has been established that Hg vapor is continuously released from amalgam fillings in human teeth (2, 3, 5) and that specific tissue loci in the sheep and monkey will concentrate large amounts of this Hg (8, 9), the possible pathophysiological consequences of such Hg exposure must be addressed. Preliminary reports on two recent investigations indicate that kidney function (16) and intestinal and gingival flora populations (17) are significantly altered when animals are exposed to amalgam Hg dose accumulations delivered from 12–16 occlusal amalgam fillings for 1–2 months after placement.

Advocacy by the dental profession (18, 19) that Hg-based silver amalgam is stable and systemically biocompatible is not supported by our animal studies (8, 9) or by the pathophysiological consequences of amalgam usage that we demonstrated (16, 17). [F1]

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REFERENCES

1. Svare, C. W., Peterson, L. C., Reinhardt, J. W., Boyer, D. B. Frank, C. W., Gay, D. D., and Cox, R. D. (1981) The effects of dental amalgams on mercury levels in expired air. *J. Dent. Res.* **60**, 1668–1671.
2. Vimy, M. J., and Lorscheider, F. L. (1985) Intra-oral air mercury released from dental amalgam. *J. Dent. Res.* **64**, 1069–1071.
3. Vimy, M. J., and Lorscheider, F. L. (1985) Serial measurements of intra-oral air mercury: estimation of daily dose from dental amalgam. *J. Dent. Res.* **64**, 1072–1075
4. Patterson, J. E., Weissberg, B., and Dennison, P. J. (1985) Mercury in human breath from dental amalgam. *Bull. Environ. Contam. Toxicol.* **34**, 459–468
5. Vimy, M. J., and Lorscheider, F. L. (1990) Dental amalgam mercury daily dose estimated from intra-oral vapor measurements: a predictor of mercury accumulation in human tissues. *J. Trace Elem. Exp. Med.* **3**, 111–123
6. Nylander, M., Friberg, L., and Lind, B. (1987) Mercury concentrations in the human brain and kidneys in relation to exposure from dental amalgam fillings. *Swed. Dent. J.* **11**, 179–187
7. Clarkson, T. W., Friberg, L., Hursh, J. B., and Nylander, M. (1988) The prediction of intake of mercury vapor from amalgams. In *Biological Monitoring of Toxic Metals* (Clarkson, T. W., Friberg, L., Nordberg, G. F., and Sager, P. R., eds) pp. 247–260, Plenum, New York
8. Hahn, L. J., Kloiber, R., Vimy, M. J., Takahashi, Y., and Lorscheider, F. L. (1989) Dental "silver" tooth fillings: a source of mercury exposure revealed by whole-body image scan and tissue analysis. *FASEB J.* **3**, 2641–2646
9. Vimy, M. J., Takahashi, Y., and Lorscheider, F. L. (1990) Maternal-fetal distribution of mercury (203-Hg) released from dental amalgam fillings. *Am. J. Physiol.* **258**, R939–R945
10. Freden, H., Hellden, L., and Milleding, P. (1974) Mercury content in gingival tissues adjacent to amalgam fillings. *Odont. Rev.* **25**, 207–210
11. Soremark, R., Wing, K., Olsson, K., and Goldin, J. (1968) Penetration of metallic ions from restorations into teeth. *J. Prosthet. Dent.* **20**, 531–540
12. Soremark, R., Ingels, O., Plett, H., and Samsahl, K. (1962) Influence of some dental restorations on the concentrations of inorganic constituents of the teeth. *Acta Odont. Scand.* **20**, 215–224

13. Moller, B. (1978) Reaction of the human dental pulp to silver amalgam restorations. Mercury determination in the pulp by flameless atomic absorption spectrophotometry. *Sacid. Dent. J.* **2**, 93–97
14. Till, T., and Maly, K. (1978) Quecksilber in Zahnwurzeln und Kieferknochen. *ZWR (Heidelb.)* **87**, 288–290
15. Danscher, G., Horsted-Bindslev, P., and Rungby, J. (1990) Traces of mercury in organs from primates with amalgam fillings. *Exp. Mol. Pathol.* **52**, 291–299
16. Vimy, M. J., Boyd, N. D., Hooper, D. E., and Lorscheider, F. L. (1990) Glomerular filtration impairment by mercury released from dental "silver" fillings in sheep. *Physiologist* **33**, A-94 (abstr.)
17. Summers, A. O., Wireman, J., Vimy, M. J., and Lorscheider, F. L. (1990) Increased mercury resistance in monkey gingival and intestinal bacterial flora after placement of dental "silver" fillings. *Physiologist* **33**, A-116 (abstr.)
18. Letters to the Editor (1990) Dental silver tooth fillings. *FASEB J.* **4**, 1542–1543
19. American Dental Association Divisions of Communication and Scientific Affairs (1990) When your patients ask about mercury in amalgam. *J. Am. Dent. Assoc.* **120**, 395–398

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Mercury from dental "silver" tooth fillings impairs sheep kidney function

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BOYD, N. D., H. BENEDIKTSSON, M. J. VIMY, D. E. HOOPER, AND F. L. LORSCHEIDER. *Mercury from dental "silver" tooth fillings impairs sheep kidney function.* Am. J. Physiol. 261 (Regulatory Integrative Comp. Physiol. 30): R1010–R1014, 1991.—In humans Hg vapor is released from "silver" amalgam fillings that contain 50% Hg by weight. Previous studies show that when 12 such fillings are placed in sheep teeth, the kidneys will concentrate amalgam Hg at levels ranging from 5 to 10 μg Hg/g renal tissue 4–20 wk after placement. In the present study 12 occlusal fillings were placed in each of six adult female sheep under general anesthesia, using standard dental procedures. Glass ionomer occlusal fillings (12) were inserted in two control sheep. At several days before dental surgery, and at 30 and 60 days after placement of fillings, renal function was evaluated by plasma clearance of inulin and by plasma and urine electrolytes, urea, and proteins. An average plasma inulin clearance rate of 69.5 ± 7.2 ml/min before amalgam placement was reduced to 32.3 ± 8.1 ml/min by 30 days and remained low at 27.9 ± 8.7 ml/min after 60 days. Inulin clearance did not change in controls. After amalgam placement urine concentration of albumin decreased from 93.0 ± 20.5 to 30.1 ± 15.3 mg/l and urine Na^+ concentration increased steadily from 24.8 ± 7.7 to 82.2 ± 20.3 mmol/l at 60 days. Concentrations of K^+, urea, γ-glutamyl transpeptidase, alkaline phosphatase, and total protein did not change significantly from 0 to 60 days in urine. Plasma levels of Na^+, K^+, urea, and albumin remained unchanged from 0 to 60 days after amalgam. Renal histology remained normal in amalgam-treated animals. It is concluded that amalgam Hg levels in kidney are sufficient to significantly reduce the rate of inulin clearance by nondefined mechanisms and that electrolyte patterns in urine are consistent with impaired renal tubular reabsorption.

dental amalgam; renal function

IN HUMANS Hg vapor is continuously released from dental "silver" amalgam fillings (which normally contain ~50% Hg by weight), and this Hg release is increased by chewing activity (27, 28). The average absorbed dose of amalgam Hg is ~10 μg Hg/day for human subjects with varying numbers of aged amalgams, and some individuals can receive dose exposures as much as 10-fold higher than this average (29, 31).

Recent reports from our laboratory demonstrate that when 12 dental "silver" fillings are placed into sheep molar teeth significant concentrations of amalgam Hg will accumulate in kidney at levels ranging from 5 to 10 μg Hg/g renal tissue 4–20 wk after placement (11, 30). Similar results have also been demonstrated in monkey kidney (10).

Inorganic and elemental Hg from sources other than dental amalgam have been shown to have a variety of effects on renal function caused by a reduction in renal blood flow (25), onset of tubular necrosis (9), and induction of autoimmune glomerular nephritis (7, 14, 22). Because amalgam Hg can be readily visualized in sheep kidney by whole-body imaging (11), the objective of the present investigation was to determine if this Hg is sufficient to alter renal function as evaluated by inulin clearance and indexes of tubular reabsorption.

METHODS

Eight adult ewes (Dorset × Suffolk) of 3–5 yr of age, average body weight 48 ± 4 kg, were used in this study. Beginning 2 wk before experimentation and for the 60 days throughout the study, these animals were maintained on a diet consisting of fresh hay fed twice daily and supplemented with Lamb Grow-Finisher Ration containing 4 g/kg Na, 0.3 mg/kg Se, and other standard trace elements and vitamins (United Feeds, Calgary, Alberta). No other salt source was provided. Each animal consumed 1.8 kg of ration daily that provided a limited Na intake of ~7 g/day. Feed consumption remained constant throughout the study. Fresh water was provided ad libitum. On the days before renal clearance testing or dental surgery, the animals were fasted for 20 h but had access to water. All renal clearance tests and dental surgeries were performed between 0800 and 1100 h daily.

In each of six sheep, occlusal amalgam fillings (Dispersalloy, Johnson & Johnson, Montreal, Quebec) were placed in 12 molar teeth under halothane general anesthesia as previously described (11). In contrast to our previous studies (11, 30), these amalgam restorations did not contain any radioactive Hg. Amalgam fillings had an average weight of ~850 mg/tooth and contained 50% pure elemental Hg. Thus the total Hg mass in each animal was ~5,100 mg. In two additional control sheep, 12 glass ionomer occlusal fillings (Ketac-Fil, ESPE, Fabrik Pharmazeutischer Präparate, Seefeld/Oberbay, Germany) were similarly placed. All fillings remained intact for the duration of this study.

Renal clearance tests were performed several days before dental surgery and at both 30 and 60 days after amalgam placement and 30 days after glass ionomer placement. Under general anesthesia, bladders were catheterized using a Rüsch balloon catheter (size 12) that was connected to a Bard urine drainage bag (2,000 ml)

(Stevens Alberta, Calgary, Alberta) strapped to the flank of the animal. Immediately after catheterization, the animals were placed in individual metabolic carts where they were maintained for 25 h to measure total urine volume collected for 1 day. Within 30 min after catheterization, all animals had fully recovered from anesthesia and at this time were provided with hay and water. Approximately 30 min later, testing of renal function commenced for 3 h.

The inulin clearance rate from plasma was determined using a microanalytic method employing β-indolyl-acetic acid as the principle colorimetric reagent (13). Each animal received a primer dose of inulin (35 mg/kg) diluted in 5 ml saline and administered into the jugular vein. This was followed by a second inulin dose (0.75 mg/kg) diluted in 50 ml saline and infused at a rate of 5 ml/min. The inulin was then allowed to equilibrate in the animal for 80 min. Blood and urine specimens were collected before inulin administration and six times (at five 20-min intervals) after equilibration. Spectrophotometric analysis was performed on a Hitachi U-2000 spectrophotometer (Tokyo, Japan) set at 530 nm. Inulin clearance rate values were multiplied 10-fold to correct for the dilution and volume of both sample and reagents used in this analytical assay method.

After inulin clearance data were collected, it was evident that kidney filtration rate had been markedly altered. Because urine and plasma specimens from the amalgam-treated sheep had been stored frozen (−20°C), other biochemical analyses were performed on these specimens to assess functional indexes of filtration and tubular reabsorption. Analyses were performed on the pre-inulin specimens collected before and at 30 and 60 days after amalgam placement. The albumin content of sheep urine was determined using a Behring Nephelometer 100 analyzer (Hoechst Canada, Montreal, Quebec) and employed rabbit antisera to sheep albumin and purified sheep albumin (Cedarlane Laboratories, Hornby, Ontario). Urine total protein was measured on a Du Pont ACA III analyzer (Du Pont Instruments, Wilmington, DE). Urine sodium, potassium, urea, γ-glutamyl transpeptidase (γ-GT), and alkaline phosphatase were measured on an Astre-8 analyzer (Beckman Instruments, Brea, CA), and plasma sodium, potassium, urea, and albumin were assayed using a Kodak E700 analyzer (Eastman Kodak, Rochester, NY).

Renal tissue samples were fixed in 10% buffered Formalin and imbedded in Historesin (Reichert-Jung, Heidelberg, Germany). Sections were cut at 2 μm and stained with hematoxylin-eosin, periodic acid-Schiff (PAS), and periodic acid-silver methenamine. Microscope magnification for photography was ×200.

Statistical comparisons were performed by analysis of variance with repeated measures.

RESULTS

Figure 1 shows the average rate ± SE of inulin clearance from plasma in six sheep before and 30 and 60 days after placement of amalgam tooth fillings, compared with that in two control sheep before and 30 days after placement of glass ionomer fillings. In amalgam-treated sheep

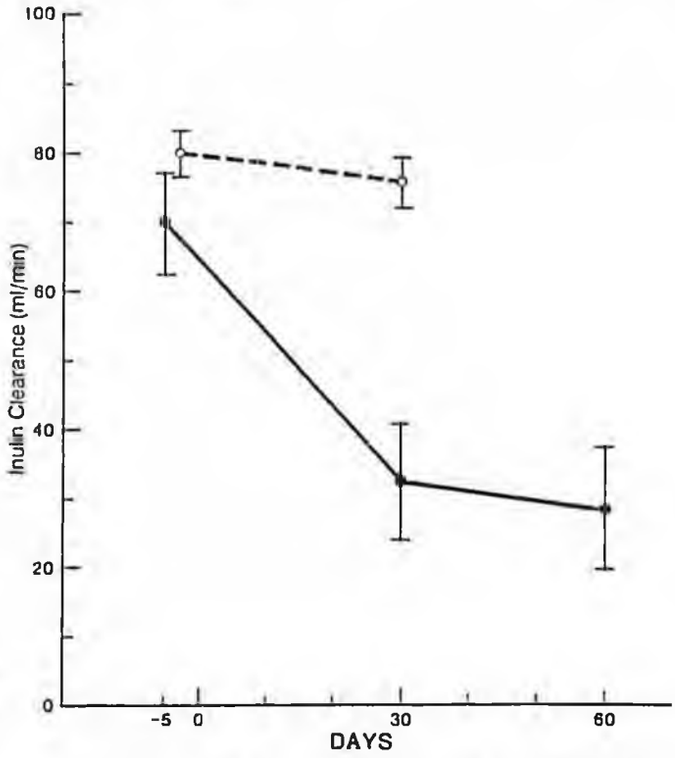

FIG. 1. Average plasma inulin clearance rate (± SE) in 6 sheep before and at 30 and 60 days after placement of "silver" amalgam tooth fillings (●) compared with inulin clearance in 2 control sheep before and 30 days after placement of glass ionomer fillings (○).

the inulin clearance markedly declined from a baseline of 69.5 ± 7.2 ml/min to 32.3 ± 8.1 ml/min by 30 days ($P < 0.01$) and remained low at 27.9 ± 8.7 ml/min by 60 days after placement of amalgam fillings ($P < 0.01$). This represented a 54% reduction in the rate of inulin clearance by 30 days, and all six animals displayed a decline (range 16–84%). By 60 days inulin clearance rate showed a 60% reduction with all animals continuing to have substantially lower kidney filtration rates (range 33–89%) than before amalgam placement. In sheep treated with glass ionomer fillings the baseline inulin clearance was 79.9 ± 2.2 ml/min, which remained unchanged 30 days later at 75.1 ± 2.6 ml/min ($P > 0.70$).

Table 1 shows the average (±SE) plasma electrolyte, urea, and albumin levels, and the urine electrolyte, urea, albumin, and total protein concentrations and enzyme activities in the amalgam-treated sheep. No significant changes were noted in plasma sodium, potassium, urea, or albumin levels after placement of dental amalgam fillings. However, urine concentration of sodium increased significantly from 24.8 ± 7.7 mmol/l before amalgam placement to 82.2 ± 20.3 mmol/l 60 days after placement ($P < 0.05$). By way of contrast, urine albumin concentration declined significantly from 93.0 ± 20.5 mg/l before amalgam placement to 30.1 ± 15.3 mg/l 60 days after placement ($P < 0.05$). Urea and potassium concentrations in urine gradually increased over the 60-day period, but these changes were not statistically significant, nor were differences in urine γ-GT, alkaline phosphatase, or total protein. Total urine volume collected during the 3-h test period after administration of inulin did not change significantly over the 60 days after

TABLE 1. *Effect of amalgam Hg on plasma electrolyte, urea, and albumin levels and on urine concentrations of electrolytes, urea, enzymes, and proteins in six sheep*

	Pre-amalgam	30 Days Post-amalgam	60 Days Post-amalgam
Plasma			
Sodium, mmol/l	156.8±6.4	150.4±2.9	141.3±10.6
Potassium, mmol/l	4.1±0.2	4.0±0.3	3.5±0.3
Urea, mmol/l	8.6±1.1	6.0±0.8	6.0±0.5
Albumin, g/l	34.0±2.1	31.0±0.9	33.3±2.3
Urine			
Sodium, mmol/l	24.8±7.7	67.5±26.2	82.2±20.3*
Potassium, mmol/l	70.2±25.1	88.0±23.0	104.4±42.1
Urea, mmol/l	324.6±117.5	378.0±73.4	401.0±50.1
γ-GT, IU/l	8.25±0.87	8.00±1.16	8.50±0.58
Alkaline phosphatase, IU/l	2.25±0.87	2.25±0.44	2.00±0.02
Albumin, mg/l	93.0±20.5	71.3±46.7	30.1±15.3*
Total protein, g/l	0.43±0.25	0.40±0.24	2.4±2.2
Volume (3-h test), ml	127.0±12.7	104.0±16.8	116.0±19.2

Values are means ± SE. γ-GT, γ-glutamyl transpeptidase; * $P < 0.05$.

amalgam placement.

Figure 2 shows the renal histology by light microscopy of tissue samples taken from two control sheep with glass ionomer fillings and two amalgam-treated sheep. No structural abnormalities of tubules, glomeruli, or renal vessels were evident in either group of animals.

DISCUSSION

The results of the present study demonstrate that Hg released from dental "silver" amalgam will significantly reduce the plasma inulin clearance rate of the kidneys by more than 50% within 1 mo after placement of these tooth fillings. By 2 mo after placement urine albumin concentration falls significantly. During this same period urine concentration of sodium increases significantly while urine volume output remains unchanged.

The values for the baseline (pre-amalgam) inulin clearance rate obtained in the present investigation agree with values previously reported for sheep of 72 ml/min, range 63–90 (20), and with other standard values for inulin clearance in sheep (12). Plasma sodium and potassium levels in samples obtained before amalgam placement agree with standard plasma electrolyte values reported for sheep of 139–164 mmol Na^+/l and 4.4–6.7 mmol K^+/l (1, 5). Urine sodium and potassium concentrations in samples taken before amalgam placement are also in agreement with mid range values derived for sheep on a sodium-limited diet that were 4–40 mmol/l for Na^+ and 40–200 mmol/l for K^+ (4). In the present study urine volume output averaged 0.64 ml/min, which agrees with flow rates obtained in similarly managed sheep of 0.5–1.0 ml/min (4). The limited daily intake of 7 g sodium in the ration provided during this study is somewhat below the recommended daily supplement of 9 g or more estab-

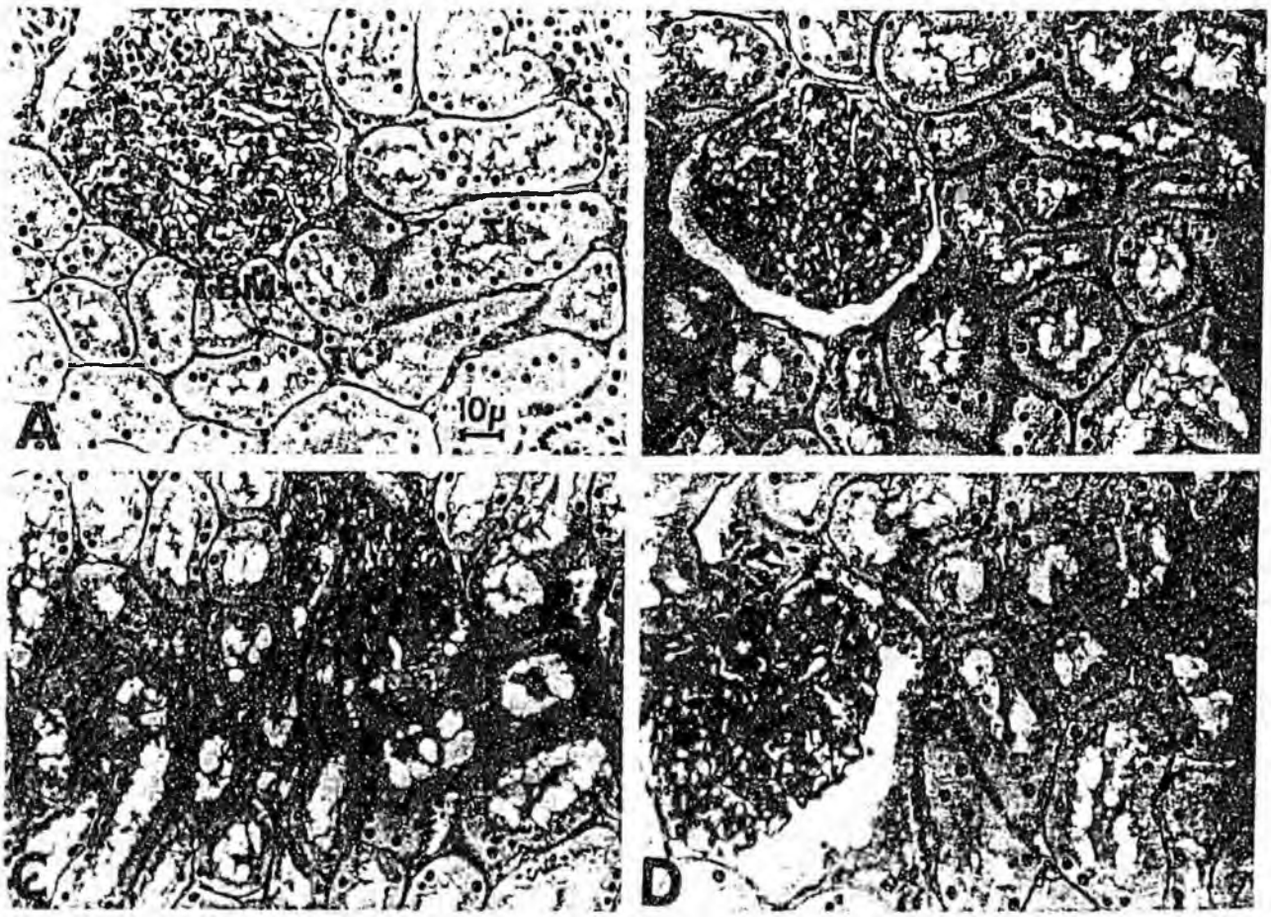

FIG. 2. Renal histology (periodic acid-Schiff stain) in 2 control sheep with glass ionomer fillings (*A* and *B*) and in 2 amalgam-treated sheep (*C* and *D*). TBM, tubular basement membrane; TC, tubular cell; G, glomerulus; TL, tubular lumen.

lished in dry lot feed tests for sheep (26).

It has been well documented that Hg from nonamalgam sources has a deleterious effect on kidney function both at the level of the glomerulus and also at the proximal tubule (7, 9, 14, 19, 22, 24, 25). The route of Hg absorption does not appear to be a factor, since both inhalation and ingestion of inorganic Hg can produce renal disease in rats (3). Our inulin clearance data clearly reveal a reduction of more than twofold in kidney filtration capacity after placement of dental amalgam. Because it is now established that large amounts of amalgam Hg will concentrate in sheep and monkey kidney tissue (10, 11, 30), the continuous release of Hg from this dental material is the likely cause of the marked reduction in inulin clearance observed in our experiments. This finding is consistent with reports by others that a single dose of mercuric chloride will reduce inulin clearance by 59% in rats (18).

There was no increase in plasma urea concentration (even though this might have been expected on the basis of decreased inulin clearance) because the data show that urea excretion was not reduced, indicative of impaired urea reabsorption. This could be a secondary effect due to reduced sodium reabsorption.

The threefold reduction in albumin excretion that was observed was not the result of an alteration in plasma albumin concentration, which remained unchanged. Albumin excretion may be influenced by an alteration in the ultrafiltration coefficient of the glomerular basement membrane and/or a reduction in renal blood flow, which has been found to reduce entry of albumin from the plasma into the glomerular filtrate (6). However, neither of these parameters was measured in the present study.

Sodium loss in the urine increased by more than threefold after placement of dental amalgams, a finding that is indicative of impaired tubular reabsorption. This is a characteristic feature of Hg toxicity and is considered to be the result of the interaction of Hg with membrane bound sulfhydryl groups, which affects tubular cell membrane permeability and cellular enzyme function (15). We believe that the increased urinary sodium excretion reflects a true decrease in tubular reabsorption, because we have no evidence of a compensating exchange mechanism operating for potassium reabsorption with sodium excretion. In fact, potassium excretion also gradually increased, although this increase was not significant. Rats acutely exposed to mercuric chloride likewise display increased fractional excretion of sodium (2, 9). Sodium is the predominant electrolyte excreted in human urine and is assumed to be a reflection of excess sodium in the normal diet. By way of contrast, sheep on limited sodium intake characteristically excrete very low levels of sodium relative to potassium (4, 8) and therefore provide a sensitive measure of reduced tubular capacity for selective conservation of sodium.

There was no increase in the urinary excretion of γ-GT and alkaline phosphatase after amalgam placement. These enzymes are located in the brush-border membrane of the proximal tubules and have been observed to be sensitive and prolonged indicators of acute Hg-induced renal damage in sheep (23) and rats (16, 17, 21). Our findings are, however, consistent with the observation that these enzyme markers may be of less value in subacute or long-term studies (17) and would indicate that the changes in tubular reabsorption of sodium that we observed are specific effects of Hg interactions with membrane proteins (15, 24) that are independent of significant cell damage. The histological data confirm the enzyme findings. No glomerular or tubular changes were evident by light microscopy after the 2-mo course of this study. This would suggest that the changes in renal function that we have observed are not due to an acute nephrotoxicity, but rather are the result of subtle subacute effects from chronic low-dose Hg exposure.

Based on the results of this study, we conclude that exposure to dental amalgam Hg, which is continuously released from routinely used "silver" tooth fillings, may have the potential to precipitate alteration in renal function. Although humans do not usually receive as many amalgam restorations at one time as have these sheep, daily amalgam Hg dose estimates for humans are nevertheless substantial (29, 31) and increase in magnitude with the number of amalgam fillings and as a function of chewing frequency (28). Individuals with 12 or more "silver" amalgam fillings comprise a significant portion of the human population. Thus the possibility of amalgam Hg-induced renal dysfunction should be considered.

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REFERENCES

1. ALTMAN, P. L., AND D. S. DITMER. *Blood and Other Body Fluids.* Bethesda, MD: FASEB, 1971, p. 36.
2. BARENBERG, R. L., S. SOLOMON, S. PAPPER, AND R. ANDERSON. Clearance and micropuncture study of renal function in mercuric chloride treated rats. *J. Lab. Clin. Med.* 72: 473–484, 1968.
3. BERNAUDIN, J. F., E. DRUET, P. DRUET, AND R. MASSE. Inhalation or ingestion of organic or inorganic mercurials produces autoimmune disease in rats. *Clin. Immunol. Immunopathol.* 20: 129–135, 1981.
4. BLAIR-WEST, J. R., A. H BROOK, AND P. A. SIMPSON. Renin responses to water restriction and rehydration. *J. Physiol. Lond.* 226: 1–13, 1972.
5. CANADIAN COUNCIL ON ANIMAL CARE. *Guide to the Care and Use of Experimental Animals.* Ottawa, Canada: 1980, vol. 1, p. 90.
6. DEEN, W. M., C. R. BRIDGES, AND B. M. BRENNER. Biophysical basis of glomerular permselectivity. *J. Membr. Biol.* 71: 1–10, 1983.
7. DRUET, P., A. BERNARD, F. HIRSCH, J. J. WEENING, P. GENGOUX, P. MAHIEU, AND S. BERKELAND. Immunologically medicated glomerulonephritis induced by heavy metals. *Arch. Toxicol.* 50: 187–194, 1982.
8. GARRY, F., D. J. CHEW, D. M. RINGS, M. J. TARR, AND G. F. HOFFSIS. Renal excretion of creatinine, electrolytes, proteins and enzymes in healthy sheep. *Am. J. Vet. Res.* 51: 414–419, 1990.

9. GONICK, H. C. Nephropathies of heavy metal intoxication. In: *Textbook of Nephrology*, edited by S. G. Massry and R. J. Glassock. Baltimore, MD: Williams & Wilkins, 1989, vol. 1, p. 834–836.
10. HAHN, L. J., R. KLOIBER, R. W. LEININGER, M. J. VIMY, AND F. L. LORSCHEIDER. Whole-body imaging of the distribution of mercury released from dental fillings into monkey tissues. *FASEB J.* 4: 3256–3260, 1990.
11. HAHN, L. J., R. KLOIBER, M. J. VIMY, Y. TAKAHASHI, AND F. L. LORSCHEIDER. Dental "silver" tooth fillings: a source of mercury exposure revealed by whole-body image scan and tissue analysis. *FASEB J.* 3: 2641–2646, 1989.
12. HECKER, J. F. *The Sheep as an Experimental Animal.* New York: Academic, 1983, p. 86.
13. HEYROVSKY, A. A new method for the determination of inulin in plasma and urine. *Clin. Chim. Acta* 1: 470–474, 1956.
14. HIRSCH, F., J. KUHN, M. VENTURA, M-C. VIAL, G. FOURNIE, AND P. DRUET. Autoimmunity induced by $HgCl_2$ in Brown-Norway rats. I. Production of monoclonal antibodies. *J. Immunol.* 136: 3272–3276, 1986.
15. HOSTETTER, T. H., AND B. M. BRENNER. Renal circulatory and nephron function in experimental acute renal failure. In: *Acute Renal Failure*, edited by B. M. Brenner and J. M. Lazarus. New York: Churchill-Livingstone, 1988, p. 71–82.
16. KIRSCHBAUM, B. B., AND D. E. OKEN. The effect of mercuric chloride on renal brush border membrane. *Exp. Mol. Pathol.* 31: 101–112, 1979.
17. KLUWE, W. M. Development of resistance to nephrotoxic insult: changes in urine composition and kidney morphology on repeated exposures to mercuric chloride or biphenyl. *J. Toxicol. Environ. Health* 9: 619–635, 1982.
18. KYLE, G. M., R. LUTHRA, J. V. BRUCKNER, AND W. F. MACKENZIE. Assessment of functional, morphological and enzymatic tests for acute nephrotoxicity induced by mercuric chloride. *J. Toxicol. Environ. Health* 12: 99–117, 1983.
19. MCCLUSKEY R. T. Immunologic mechanisms in glomerular disease. In: *Pathology of the Kidney*, edited by R. H. Heptinstall. Boston, MA: Little, Brown, 1983, vol. 1, p. 338–339.
20. MCDONALD, J., AND W. V. MACFARLANE. Renal function of sheep in hot environments. *Aust. J. Agric. Res.* 9: 680–692, 1958.
21. NICHOLSON, J. K., J. A. TIMBRELL, AND P. J. SADLER. Proton NMR spectra of urine as indicators of renal damage: mercury induced nephrotoxicity in rats. *Mol. Pharmacol.* 27: 644–651, 1985.
22. PELLETIER, L., R. PASQUIER, F. HIRSCH, C. SAPIN, AND P. DRUET. Autoreactive T cells in mercury-induced autoimmune disease: in vitro demonstration. *J. Immunol.* 137: 2548–2554, 1986.
23. ROBINSON, M., AND J. TRAFFORD. A study of early urinary enzyme changes in mercuric chloride nephropathy in sheep. *J. Comp. Path.* 87: 275–280, 1977.
24. SOLEZ, K. Acute renal failure—"acute tubular necrosis", infarction, and cortical necrosis. In: *Pathology of the Kidney*, edited by R. H. Heptinstall. Boston, MA: Little, Brown, 1983, vol. II, p. 1103–1107.
25. SOLOMON, H. S., AND N. K. HOLLENBERG. Catecholamine release: mechanism of mercury-induced vascular smooth muscle contraction. *Am. J. Physiol.* 229: 8–12, 1975.
26. SUBCOMMITTEE ON SHEEP NUTRITION, COMMITTEE ON ANIMAL NUTRITION, NATIONAL RESEARCH COUNCIL. *Nutrient Requirements of Domestic Animals. 5. Nutrient Requirements of Sheep.* Washington, DC: Natl. Acad. Sci., 1975, p. 7.
27. VIMY, M. J., AND F. L. LORSCHEIDER. Intra-oral air mercury released from dental amalgam. *J. Dent. Res.* 64: 1069–1071, 1985.
28. VIMY, M. J., AND F. L. LORSCHEIDER. Serial measurements of intra-oral air mercury: estimation of daily dose from dental amalgam. *J. Dent. Res.* 64: 1072–1075, 1985.
29. VIMY, M. J., AND F. L. LORSCHEIDER. Dental amalgam mercury daily dose estimated from intra-oral vapor measurements: a predictor of mercury accumulation in human tissues. *J. Trace Elem. Exp. Med.* 3: 111–123, 1990.
30. 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.
31. WORLD HEALTH ORGANIZATION. *Environmental Health Criteria. Inorganic Mercury.* Geneva: World Health Organization, vol. 118, 1991, p. 36.

The Relationship between Mercury from Dental Amalgam and Mental Health*

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The findings presented here suggest that mercury poisoning from dental amalgam may play a role in the etiology of mental illness. Comparisons between subjects with and without amalgam showed significant differences in subjective reports of mental health. Subjects who had amalgams removed reported that symptoms of mental illness lessened or disappeared after removal. The data suggest that inorganic mercury poisoning from dental amalgam does affect the mind and emotions.

INTRODUCTION

Mercury Poisoning and Psychological Disorders

Evidence linking mercury exposure to psychological disorders has been accumulating over the past 60 years. Psychological symptoms of mercury poisoning are erethism[1] (irritability, excitability, outbursts of temper and quarreling), extreme shyness and avoidance of strangers, anxiety, tension, depression, and forgetfulness. In severe cases, hallucinations, suicidal tendencies, melancholia, and manic-depressive psychosis may occur.

Mercury poisoning disrupts the emotional sphere and produces psychological disorders as a result of mercury's strong affinity for brain tissue. This paper gives evidence that mercury from dental amalgam may be causing psychological disturbances.

Cases of Mercury-induced Psychological Disorders

During the last century, felt-hat makers were regularly exposed to mercuric nitrate. They became known as "Mad Hatters" because of the emotional problems they developed, including sudden anger, drowsiness, depression, loss of memory, timidity, insomnia, hallucinations, delusions, and mania. In 1941, brain damage due to mercury poisoning was identified as the cause of the Mad Hatter syndrome.[2]

Mayhazati[3] reported on the psychological evaluations of 6,530 Iraqi patients hospitalized after exposure to an organic mercury pesticide. Of 53 mercury-poisoned patients in one hospital, 26 revealed psychological disorders. They were

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depressed, lacked interest, manifested auditory or visual hallucinations, had deficient concentration and poor short-term memory. Of the 43 mercury-poisoned patients in another hospital, 31 were depressed and 19 showed irritability.[4]

Mercury poisoning at Minimata Bay in Japan (now called Minimata Disease) resulted in an increase in the number of babies who developed cerebral palsy and mental retardation. Of the 400 babies born during the time of the mercury poisonings, 24 developed cerebral palsy and many developed mental retardation.[2] Mercury passes easily through the placenta and accumulates in the fetus; therefore, neonates are more likely to suffer mercury toxicity than their mothers.[6]

A Russian study of prenatal mercury poisoning found that 7 of 10 new babies exposed to mercury in utero were mentally retarded, while a report from Sweden identified a mother who had eaten seed treated with alkyl mercury and was unaffected but her child was born with severe retardation.[7]

Workers exposed to mercury vapors in a thermometer factory exhibited a wide range of psychological abnormalities, including forgetfulness, headaches, irritability, poor concentration, and insomnia. They scored below established norms on tests of intelligence, personality, and motor skills. After the exposure to mercury had stopped, their test scores returned to normal within 20 months, except for short-term memory, which remained impaired.[8]

Three dentists who were exposed to mercury in their practices developed symptoms of irritability, excitability, fearfulness, restlessness, melancholy, depression, timidity, fatigue, weakness, indecisiveness, headaches, and hopelessness. These symptoms disappeared after their mercury levels were reduced by medication.[9]

Rats exposed to mercury vapor were found to increase their spontaneous aggressive behavior. Mercury levels as low as 0.002 mg Hg/m^3 were sufficient to induce behavior change.[8] Anger is a common symptom of mercury toxicity.

The evidence suggesting a relationship between psychological disorders and mercury poisoning led Alzheimer's disease researchers to compare post-mortem brain-tissue samples of Alzheimer's patients to a control group. They found elevated levels of mercury in the Alzheimer's samples. In fact, this mercury imbalance is the largest trace-element imbalance that researchers have observed to date. The source of the brain mercury is not known, but dental amalgam has been suggested as a possible source.[10]

Mercury Poisoning and Dental Amalgam

Four factors led us to study the relationships among dental amalgam, mercury poisoning, and mental health: (1) mercury's affinity for brain tissue, (2) the relationship between mercury poisoning and psychological disorders, (3) the proximity of mercury-laden dental amalgam to the brain, and, (4) the release of mercury vapor from the amalgam.

Mercury is one of the most toxic metals since it disrupts most biological systems as a result of its affinity for sulfhydryl groups, which are functional components of most enzymes and hormones.[11] Over a long period, small amounts of mercury exposure can produce the same devastating effects as a large dose in a short time. Insidious long-term exposure to mercury can produce damage after many years with no trace of the etiology of the problem.[12]

Stock[13] found that 3 $\mu g/m^3$ of mercury in the air during constant work did not cause noticeable health symptoms except for people with hypersensitivity to mercury. Daily mercury concentrations of 10–20 $\mu g/m^3$ in the work room produced physical and mental symptoms in the majority of employees. However, Stock reported that neurological symptoms associated with a mercury concentration of 2.1 $\mu g/m^3$ in expired air disappeared after amalgam removal.

In the United States and Europe, the maximum allowable mercury concentration is 50 $\mu g/m^3$ in the air.[12] This concentration is based on a daily exposure of 8 hours/day during a 5-day work week. In the Soviet Union and Sweden, the standard is 10 $\mu g/m^3$.

Nearly 80 percent of the world's dental caries are filled with dental amalgam (silver fillings). This unstable alloy is approximately 50 percent mercury and continuously releases elemental mercury.[14,15]

Inorganic mercury in amalgam may be methylated by bacteria, such as streptococcus mutans, which also cause dental caries.[16] Methyl mercury is one of the most toxic forms of mercury.

According to Gay[14] and Svare,[15] mercury vapors are released from dental-amalgam restorations. They found a direct correlation between the amount of mercury released and the number of amalgams. More mercury (up to 87.5 $\mu g/m^3$) is released during chewing. Newer fillings release four times as much mercury after chewing than before, and week-old fillings show a 17-fold increase in mercury released after chewing.

Vimy and Lorschneider[17] measured intra-oral mercury and calculated that subjects with twelve or more occlusal amalgam surfaces received an average daily dose of 29 μg of mercury. Subjects with one to four amalgams received an average daily dose of 9 μg. These levels exceed many countries' accepted standards for environmental mercury exposure. Radics et al.[18] analyzed the outer corroded area of an amalgam that was depleted of mercury. His calculations suggested that a mouth with many fillings could release up to 560 mg of mercury over several years. If the loss took place over ten years, the daily dose would be 150 μg., a very toxic dose.

Pleva[19] found that the chewing surface of a 5-year-old amalgam had lost almost half its mercury; a 20-year-old amalgam had no mercury left on the chewing surface. Pleva, a corrosion scientist in Sweden, described his multitude of health problems of 20-year duration. It was only after he had discovered the corrosion of his amalgams that he began to suspect mercury poisoning. Within

three months after amalgam removal, most of his mental health symptoms—anxiety, irritability, indecision, tiredness, loss of interest, feeling old, resistance to intellectual work, feeling stressed—disappeared.

Mercury's Path to the Brain

Mercury is released from dental amalgam as elemental mercury vapor. An average of 75 to 80 percent of the elemental mercury vapor can be inhaled and absorbed through the alveoli of the lungs where it passes into the blood stream rapidly and completely.[6,20] Elemental mercury (Hg^0) passes through the blood-brain barrier before it is ionized and is retained within the brain. Dissolved elemental mercury is detectable in the blood up to 15 minutes after exposure to mercury vapor. Mercury vapor can remain in the blood for more than one circulation and is oxidized by the catalase system to the toxic mercuric ion.[11]

In studies of rats exposed to elemental mercury vapor, 20 percent of the absorbed mercury remained in the brain after six months.[21]

Another avenue of mercury poisoning from dental amalgam may be by absorption through the valveless cranial venous system. Mercury vapor may settle down into the oronasal region and be absorbed directly into the venous system to the brain. Störtebecker[16] found evidence that mercury vapors are deposited in the upper nasal part of the ethmoid region. Mercury could be transported via the filia olfactory to the olfactory bulbs on the base of the skull, and then into the brain.

In animal experiments with mercury vapor, Stock[13] measured a high concentration of mercury in the olfactory lobe and frontal brain.

Eggleston et al.[22] confirmed this finding in humans by performing post-mortem analyses on various brain regions. He found higher concentrations of mercury in the olfactory region and pituitary gland in humans with amalgams compared to those without. He also found a direct correlation between the number of amalgams and the mercury concentrations in the brain.

METHOD

The strong evidence linking dental amalgam with mercury poisoning and associated psychological disorders led us to design a study that evaluated the mental health of subjects with and without dental amalgam.

SUBJECTS

We selected 70 subjects from respondents to ads in the local college newspaper; 23 subjects volunteered from student physiology labs; and 8 came from a local fraternity house. None was paid.

The amalgam and nonamalgam groups were matched for sex and age. Of the 101 subjects, 50 (30 females and 20 males) had amalgams and 51 (30 females and 21 males) had no dental fillings. The average age of the nonamalgam group was

22.35 compared to 23.28 for the amalgam group. The males averaged 10.1 amalgams and the females 9.8.

Mercury Tests

A hair sample from the nape of the neck and a urine specimen, the first upon arising in the morning, were obtained from each subject and analyzed for mercury content (Table I).

Mental Health Questionnaires

Volunteers completed two mental-health questionnaires designed to evaluate their subjective perception of their mental status. One survey was completed at home and the other while waiting for lab testing.

Health questionnaire I (Table II) asked subjects to rate their stress tolerance, stress level, emotional and physical health, their happiness, peace of mind, reading comprehension, and grade-point average.

Health questionnaire II (see Table III) asked whether the respondent experienced emotional or psychological symptoms, such as sudden anger, depression, irritability, suicidal tendencies, or frequent anxiety. It evaluated additional psychological distress symptoms, including lack of interest, shyness, nightmares, forgetfulness, lack of confidence, nervousness, fear, loss of memory, and indecisiveness.

In addition to the test groups, a mental-health questionnaire also was sent to nearly 300 subjects who had their amalgams removed by a Utah dentist. Eighty-six of them responded, including 60 females and 26 males who averaged 40.41 years in age. This aspect of the study was not controlled and the epidemiological information acquired did not account for any placebo effect. Subjects were asked to list any mental health symptoms they had within the year before amalgam removal. They were then instructed to evaluate such symptoms after amalgam removal by stating if they had improved, got worse, were eliminated, or did not change. The mean number of amalgams reported removed

TABLE I.

MERCURY IN TISSUE

	Amalgam	S.D.	Non-Amalgam	S.D.	% Difference	Significance (P)
Hair Mercury (ppm)	1.43	0.50	1.13	0.54	26.5%	0.008
Urine Mercury (ppb)	3.70	3.78	1.23	1.79	201%	0.0002

TABLE II

HEALTH QUESTIONNAIRE I

Question	Non-Amalgam	S.D.	Amalgam	S.D.	Significance (P)
MENTAL					
1. Stress Tolerance*	1.76	0.67	1.70	0.63	0.296
2. Amount of Stress*	2.30	0.55	2.41	0.54	0.157
3. Emotion Level*	2.13	0.49	2.26	0.61	0.122
4. Health**	8.36	1.50	8.15	1.03	0.220
5. Happiness**	8.48	1.09	8.02	1.41	0.047
6. Peace of Mind**	8.02	1.36	7.54	1.76	0.075
7. Reading Comprehension:					
Good	41		35		
Average	5		12		
Poor	0		0		0.04
8. Grade Point Average (on a 4.0 scale)	3.15	0.44	3.07	0.36	0.196

*(1 good, 2 average, 3 poor)
**(scale 1-10, 10 best)

was 10.77 and the last amalgam removal averaged 9.95 months before they completed the questionnaire.

Physical Assessments

A dental assistant and dental hygienist recorded the dental status of each subject. A complete blood count, which included a hemoglobin count, was taken for each subject.

Data Analysis

The data were analyzed by chi square, an analysis of variance, Pearson Correlation Coefficient, and Spearman Correlation Coefficient.

RESULTS

Mercury in Tissues

The tissue levels of mercury were 201 percent higher ($P = 0.0002$) in urine samples of the members of the amalgam group and their haar mercury levels were

TABLE III

HEALTH QUESTIONNAIRE II

Symptoms	Non-Amalgam n=48	Amalgam n=47	Significance (P)
EMOTIONAL AND MENTAL			
1. Sudden Anger	1	10	0.0046
2. Depression	7	18	0.008
3. Wish you were dead	2	4	0.327
4. Irritability	9	19	0.018
5. Suicidal Tendencies	1	4	0.173
6. Divorced	0	1	0.495
7. Frequent Anxiety	9	13	0.225
TOTAL	29*	69*	0.007

*.60 symptoms/subject
**1.47 symptoms/subject

145% more symptoms/subject in amalgams group.

26.5 percent higher (P = 0.008) in hair samples (Table I). Within the amalgam group, urine mercury correlated directly with the number of fillings (r = 0.46, P = 0.001) as did hair mercury (r = 0.23, P = 0.09). These findings support those of Abraham,[23] who found higher blood-mercury levels in amalgam-bearing subjects, and Svare and Peterson,[24] who measured a decrease in blood-mercury levels after amalgam removal.

Mental Health Questionnaire I

Amalgam subjects reported being significantly less happy and having less peace of mind; they rated their reading comprehension as being significantly lower (Table II). Although not at a significant level, they rated themselves as being less healthy, having more stress, and being more emotional than nonamalgam subjects.

Mental Health Questionnaire II

The amalgam subjects reported more emotional-distress symptoms (145%). They indicated significantly more episodes of sudden anger, depression, and irritability. Suicidal tendencies and anxiety were also found more frequently in

the amalgam group (Table III). They experienced more nightmares (amalgam = 7, nonamalgam = 4, P = 0.285), were more nervous (amalgam = 12, nonamalgam = 8, P = 0.26), experienced fear (amalgam = 6, nonamalgam = 3, P = 0.26), had poorer concentration (amalgam = 12, nonamalgam = 8, P = 0.26), lacked confidence (amalgam = 10, nonamalgam = 5, P = 0.15), had more difficulty making decisions (amalgam = 10, nonamalgam = 6, P = 0.196), had poorer attention (amalgam = 7, nonamalgam = 4, P = 0.285), and were more forgetful (amalgam = 10, nonamalgam = 8, P = 0.438). While these symptoms are not individually statistically significant between groups, when all these symptoms are totalled, the amalgam group reported 60.9 percent more symptoms.

When lifestyle was assessed, the amalgam group appeared to have a poorer lifestyle defined by these factors: They craved and ate more sweets (amalgam = 10, nonamalgam = 6, P = 0.21), smoked more cigarettes (amalgam = 6, nonamalgam = 1, P = 0.08), consumed more alcohol (>1 alcoholic drink daily, amalgam = 5, nonamalgam = 3, P = 0.38), and drank more coffee (>2 cups of coffee daily; amalgam = 14, nonamalgam = 9, P = 0.175) than the nonamalgam group.

Amalgam-removed Group Responses

Not all 86 respondents in the with amalgam-removed group responded to each question. Sixty-seven (80%) of 84 reported they felt better since removal; 78 (91%) of 86 were glad they had undergone the removal, and 76 (88%) of 86 said they would undergo the procedure again (Table IV). Only three subjects reported feeling worse after removal.

After removal, subjects reported they were 47.8 percent more tolerant to stress with 53 (68%) of 78 respondents of the group reporting better tolerance; 35 (44%) of 79 respondents felt they were less emotional. Health improved in 63.8 percent of the volunteers following amalgam removal and no one reported deterioration in health. The subjects in the whole group reported their health improved by an average of 26.2 percent. Happiness and peace of mind improved in 46 (58%) of 79 respondents. The overall group rated themselves as 26.4 percent happier and felt they had 27.6 percent more peace of mind.

The 86 subjects reported a total of 409 psychological symptoms before removal. Within an average of ten months after removal, 275 (67%) of the symptoms improved, 62 (15%) were eliminated, 61 (15%) did not change, and 10 (3%) got worse.

Of 31 subjects reporting sudden anger, 28 (90%) said that emotion had weakened or was eliminated. Depression was reported by 38 subjects before removal, and 32 (84%) of depressive symptoms were improved or eliminated. Irritability, a common result of mercury exposure, lessed in 29 (83%) of 35 subjects after removal. Many other symptoms associated with mercury toxicity improved after amalgam removal; frequent anxiety was lessened or eliminated in

TABLE IV

HEALTH QUESTIONNAIRE I
AFTER AMALGAM REMOVAL

A. Feeling Better: Yes - 67 (80%); No - 17 (20%)
On a scale of 0% to 100%, the subjects said they felt an average of 48% better after removal. The 67 subjects which felt better, felt 59% better.

B. Feeling Worse: Yes - 11 (14%); No - 70 (86%)
Of the 11 subject who said they felt worse, 9 said they also felt better after removal. Some said they felt worse immediately after removal, then felt better. Only 3 felt worse after amalgam removal than before. On a scale of 0% to 100%, the 11 subjects that felt worse said they felt 21% worse, but said they felt 47% better on the "feeling better" question.

C. Adverse Effects: Yes - 30 (37%); No - 52 (63%)
Most adverse effects were minor, and cleared up shortly after amalgam removal.

D. Are you glad you had your amalgams removed?
Yes - 78 (91%)
No - 1 (1%)
No Response - 7 (8%)

E. If you had to do it again, would you have your amalgams removed?
Yes - 76 (88%)
No - 8 (9%)
No response - 2 (2%)

F. Did you have any gold filling in your mouth at the same time you had amalgam fillings?
Yes - 32 (37%)
No - 50 (58%)
No Response - 4 (5%)

G. Do you crave sweets?
Before removal: Yes - 49 (60.4%); No - 32 (39.5%)
After removal: Yes - 32 (39.5%); No - 33 (40.7%);
Less - 16 (19.8%)

31 (89%) of 35 subjects; nervousness declined in 23 (82%) of 28 patients; nightmares got better in all 12 subjects; all 10 subjects who reported suicidal tendencies said that condition was improved or eliminated; forgetfulness improved in 20 (63%) of 32 subjects; while 19 (73%) of 26 subjects reported their memory improved; and confidence increased in 21 (84%) of 25 volunteers who had their amalgams removed. Before amalgam removal, 49 (60.4%) of the 81 respondents craved sweets and, after removal, only 30 (39.5%) did.

Subjects with amalgams tired more easily compared to nonamalgam volunteers (amalgam = 11, nonamalgam = 2, P = 0.007) and more amalgam subjects complained of being tired in the morning (amalgam = 25, nonamalgam = 10, P = 0.001). After amalgam removal, 18 (53%) of 34 subjects said their fatigue was improved or eliminated, and they were not as tired in the morning. Another 21 (54%) of 39 subjects said they did not tire as easily.

DISCUSSION

Dental Amalgam and Mercury Toxicity

The relationships between dental amalgam, mercury poisoning, and psychological disorders are provocative and may have significant implications for effective mental health treatment. Although the number of subjects in this study is small (50 subjects with amalgam and 51 subjects without), the results are statistically significant and warrant additional research.

Our data demonstrate that tissue levels of mercury are higher in amalgam-bearing subjects. Dental amalgam produces higher concentrations of mercury in the blood, which may be deposited in the brain, as Eggleston found in a post-mortem study.[22]

The toxicity of mercury in the brain and the psychological symptoms that result are well established in the cases reviewed here. The psychological symptoms of mercury poisoning occurred significantly more often in the amalgam group in our study, suggesting that mercury toxicity from the breakdown of dental amalgam could be a cause of psychological disorders. Amalgam subjects reported more irritability, depression, fatigue, suicidal thoughts, anxiety, sudden anger, fear, nervousness, and memory loss than subjects without amalgam.

If mercury toxicity from dental amalgam causes psychological distress symptoms, removal of the amalgam should alleviate the symptoms, a finding that is supported by reports from 86 amalgam-removal subjects. These subjects found that 82 percent of their psychological disorders were either improved or eliminated after amalgam removal within an average of 10 months.

Mercury and Stress

Stress is now recognized as one of the leading causes of health problems. Most of the mental health problems caused by mercury are stress symptoms such as anger, irritability, and anxiety. The ability to manage stress is directly related

to a person's mental health. More than 68 percent of the subjects reported their stress tolerance improved after amalgam removal. Perhaps their 48 percent greater tolerance to stress after amalgam removal would explain their increase in reported happiness, peace of mind, and improved mental health. This evidence suggests that the environmental stress of mercury from dental amalgam could be an unrealized burden, resulting in adverse mental-health effects.

Mercury and Fatigue

Fatigue is characteristic of mercury toxicity. The subjects with amalgam complained significantly more of tiring easily and feeling tired upon awakening compared to the group without amalgams. One hypothesis to explain this fatigue is the significantly lower hemoglobin counts of amalgam-bearing subjects found in this study. A significant correlation was found between high urine mercury levels and low hemoglobin levels ($r = 0.42$, $P = 0.003$).

This evidence suggests that mercury may impair hemoglobin's ability to carry oxygen, which would produce fatigue. Hemoglobin has a number of key sulfhydryl groups, which may attract mercury. We also found that mercuric chloride causes free oxyradicals in the hemoglobin molecule which contributes to an increased oxidation rate and the destruction of the molecule. This may explain why fatigue symptoms improved or were eliminated in 18 (53%) of 34 subjects after amalgam removal.

Mercury and Memory

Amalgam subjects reported poorer reading comprehension. Forty-five percent of the respondents whose amalgams were removed, felt their reading comprehension improved. Inorganic mercury toxicity causes a loss of short-term memory.[8] This mercury-related memory impairment may underlie the poor reading comprehension. Correlative evidence for this hypothesis comes from a Department of Education study that found children's reading comprehension had improved since 1971—a time of decreasing dental caries in children.[25]

Mercury and Pre-menstrual Syndrome

In this study women with amalgams reported significantly more menstrual difficulties than those without (amalgam = 16, nonamalgam = 10; $P = 0.09$). Of 12 women reporting menstrual disorders whose amalgams were removed, 9 said their problems were improved or eliminated after removal. Lamperti's study of the hamster found that mercuric chloride suppressed progesterone levels and affected the estrous cycle.[26] Mercury retarded the follicular development in the ovaries and damaged the luteal cell membrane of the corpus lutea, which is necessary for steroid production. Lamperti concluded that "mercury directly affected the responsiveness of the ovary and pituitary to hormonal stimulation." Many emotional and mental problems are associated with premenstrual syndrome.

Mercury and Lifestyle

The lifestyle questionnaire found the lifestyle of the amalgam group to be poorer than the nonamalgam group. They craved and ate more sweets, smoked more cigarettes, drank more coffee, and consumed more alcohol. Could this lifestyle contribute to the poorer health of the amalgam subjects or is it the result of mercury toxicity from dental amalgam? Maybe both. We hypothesize that if people are nervous, depressed, angry, and tired—as amalgam-bearing subjects are—they might drink more coffee as a stimulant to fight fatigue, smoke more cigarettes as a nervous habit, and drink more alcohol because they are depressed. Emotional problems can lead to substance abuse, and a link may exist between mercury toxicity and these problems.

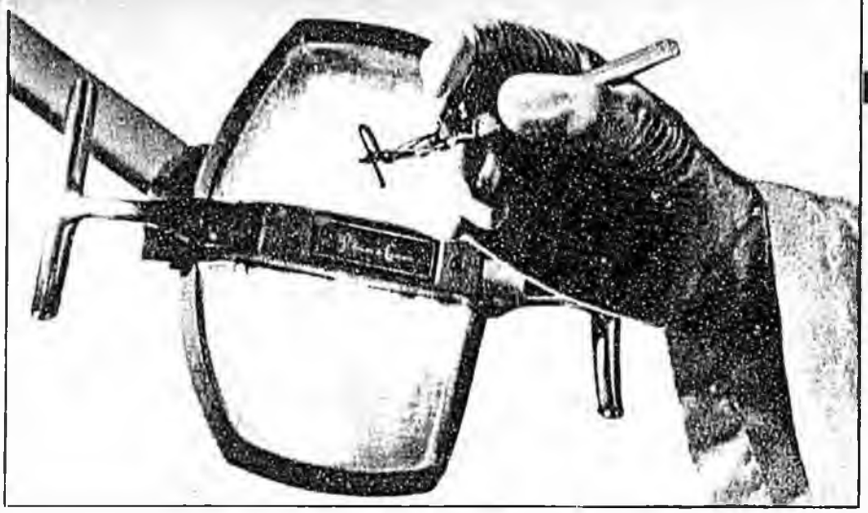
SUMMARY

The most common symptoms of inorganic mercury poisoning are related to mental health. The data presented here suggest that the release of mercury vapor from dental amalgam may cause mercury toxicity and produce psychological distress symptoms. Dental mercury, which is universally used, may be a significant health hazard. Psychotherapists should consider mercury toxicity as a possible cause in the treatment of psychological disorders from mild stress-related complaints to cases of schizophrenia, paranoia, and the other severe psychological diseases.

REFERENCES

1. Ross, W. D., Gechman, A., Sholiton, M., and H. Paul. Need to Alertness for Manifestations of Inorganic Mercury Poisoning. *Compr. Psychiatry*, 18:595-98, 1977.
2. Gowdy, J., and Demers, F. The Blood Mercury Levels in Mental Hospital Patients. *Am. J. Psychiatry*, 135:115-16, 1978.
3. Mayhazati, H. I. Psychiatric Aspects of Methyl Mercury Poisoning. *J. Neurol. Neurosurg. Psychiatry*, 37:954-58, 1974.
4. Rustram, R. Methyl Mercury Poisoning in Iraq. *Brain*, 97:499-510, 1974.
5. Trachtenberg, I. M. *Chronic Effects of Mercury on Organisms*. U.S. Dept. of Health, Education, Welfare, NIH, DHEW Publ., 1974.
6. Friberg, L., and Vostal, J. *Mercury in the Environment*. CRC Press, Cleveland, Ohio, 1972.
7. Koos, B., and Longo, L. Mercury Toxicity in the Pregnant Woman, Fetus, and Newborn Infant. *Am. J. Obstet. Gynecol.*, 126:395-409, 1976.
8. Evans, H., Laties, V., and Weiss, B. Behavioral Effects of Mercury and Methylmercury. *Federation Proc.*, 34:1858-67, 1975.
9. Smith, D. Mental Effects of Mercury Poisoning. *South Med. J.*, 71:9045, 1978.
10. Thompson, C., Markesberg, W., Ehman, W., et al. Regional Brain Trace Element Studies in Alzheimer's Disease. *Neurotoxicology*, 9:1-8, 1988.
11. Clarkson, T. W. The Pharmacology of Mercury Compounds. *Ann. Rev. Pharmacol.*, 12:375-406, 1972.
12. Hanson, M. Amalgam—Hazards in Your Teeth. *J. Orthomolec. Psychiatry*, 12:194-201, 1983.
13. Stock, A. Die chronische Quecksilber und Amalgam Vergiftung. *Arch. Gewerbepath.*, 7:388, 1936.
14. Gay, D. D., Cox, R. O., and Reinhardt, J. W. Chewing Releases Mercury from Fillings. *Lancet*, 1:984-85, 1979.

15. Svare, C. W., Peterson, L. C., Reinhardt, J. W., et al. The Effect of Dental Amalgams on Mercury Levels in Expired Air. *J. Dent. Res.*, 60:1668-71, 1981.
16. Störtebecker, P. *Mercury Poisoning from Dental Amalgam*. Störtebecker Fdn. for Res., Bioprobe, Orlando, FL., pp 138, 149, 151-54, 1985.
17. Vimy, M. I., and Lorschneider, F. L. Serial Measurements of Intraoral Air Mercury: Estimation of Daily Dose from Dental Amalgam. *J. Dent. Res.*, 64:1072-75, 1985.
18. Radics, J., Schwander, H. and Gasser, B. Die kristallinen Komponenten der silberamalgam Untersuchungen mit der elektronischen Röntgen Mikrosonde. *Zahnärztl. Welt*, 79:1031, 1970.
19. Pleva, J. Mercury Poisoning from Dental Amalgam. *J. Orthomolec. Psychiatry* 12:184-93, 1983.
20. Hursh, J. B., Clarkson, T. W., Cherian, M. G., et al. Clearance of Mercury (Hg-197, Hg-203) Vapor Inhaled by Human Subjects. *Arch. Environ. Health*, 31:302-09, 1976.
21. Gage, J. C. The Distribution and Excretion of Inhaled Mercury Vapor. *Br. J. Ind. Med.*, 18:287, 1961.
22. Eggleston, D. W., and Nylander, M. Correlation of Dental Amalgam with Mercury in Brain Tissue. *Res. Ed.*, 58:704-07, 1987.
23. Abraham, J. E., Svare, C. W., and Frank, C. W. The Effect of Dental Amalgam Restorations on Blood Mercury Levels. *J. Dent. Res.*, 63:71-73, 1984.
24. Svare, C. W., and Peterson, L. L. The Effect of Removing Dental Amalgam on Mercury Blood Levels. *J. Dent. Res.*, IADR Abst. #896, 1984.
25. Cassidy, P. News Release about Reading. *Inter. Reading Assn. News*, Newark, DE., 1985.
26. Lamperti, A., and Printz, R. Localization, Accumulation, and Toxic Effects of Mercuric Chloride on the Reproductive Axis of the Female Hamster. *Biol. Reprod.*, II:180-86, 1974.



THE MERCURY IN YOUR MOUTH

You can avoid amalgam fillings or even replace the ones you have. But should you?

Last December, when the popular CBS-TV show "60 Minutes" suggested that the mercury in dental fillings is a perilous poison, thousands of viewers besieged their dentists about having their amalgams removed. Switchboards lit up at state dental societies, dental schools, and the American Dental Association (ADA). Groups opposed to dental amalgam were inundated with inquiries. And two New Mexico state legislators were moved to introduce a bill banning amalgam fillings.

The fear raised by the "60 Minutes" report is understandable. After all, dental amalgam is an intimate part of the American experience. Each year in the U. S., up to 100 million of the silver-colored fillings are used to restore decayed teeth. Almost half of each filling is mercury, which is combined with silver, tin, and other metals. If amalgam does cause ills ranging from migraines to multiple sclerosis, a possibility "60 Minutes" left wide open, the vast majority of the population is at risk.

Spinoffs from the "60 Minutes" program—local TV shows, radio interviews, newspaper articles—have kept public anxiety high. Local chapters of the grass-roots support group DAMS (for Dental Amalgam Mercury Syndrome) report that requests for information have continued, months after the network show.

Some patients contacting their dentists may have their worries confirmed. Dr. Louis Beaudette, president of the Vermont State Dental Society, told the Burlington Free Press that he'd recommend amalgam removal for people who have illnesses with no known cause. "I'd say, 'Take them out. You have nothing to lose,' " Beaudette was quoted as saying.

Faced with growing public concern, the National Institute of Dental Research (NIDR) is reluctantly discussing a large-scale investigation to look for a link between dental amalgam and assorted health problems. "We're not convinced we need a nationwide epidemiologic study," says Dr. Joyce Reese, an NIDR health scientist administrator. "We have no evidence that amalgam is a health threat. But we want answers that will put this issue to rest."

A running battle

The current skirmish is only the latest in what's come to be known as the Amalgam Wars. Amalgam drew fire in 1979, when University of Iowa researchers, using sensitive new measurement techniques, found that chewing releases tiny amounts of mercury vapor from fillings. This ran counter to the prevailing belief that no vapor escapes once amalgam has hardened, and scientists began to take a closer look. They found—in some but not all studies—that people with amalgam fillings had more mercury in their blood and urine than did those without, and that the levels seemed to correlate with the size and number of fillings. Further, a few autopsy studies showed more mercury in the brain tissue of people with amalgams. These suggestions that mercury liberated from fillings finds its way into body tissues became ammunition for amalgam foes.

It has long been known that mercury vapor can have toxic effects, particularly on the brain and nervous system. Exposed to high mercury levels for long periods, workers in thermometer factories and elsewhere have experienced severe tremors, confusion, vision and speech problems, and inflamed gums. Exposure to lower levels can cause weakness, fatigue, minor tremors, and other symptoms.

The question in the amalgam debate is whether the minute amount of mercury vapor thought to emanate from fillings has any health effect at all.

A tale of six sheep

Late last year it appeared a smoking gun had been found. Researchers at the University of Calgary in Alberta, Canada, placed 12 amalgam fillings in each of six sheep. Within two months, they reported, the test animals had lost 60 percent of kidney function, while two control sheep had lost none. The "60 Minutes" segment showed a seemingly alarming X-ray of a sheep's mercury-laced digestive tract while reporting on the study uncritically.

However, experts in biochemistry, toxicology, and veterinary medicine have been highly critical of the study. The first problem, say critics, is that sheep are an inappropriate model. Sheep have large, flat teeth that wear down and erupt anew. They are ruminants: They chew, swallow, and rechew their food 15 hours a day. And their diet of grass and grains is fairly abrasive. Those factors alone would cause dental fillings to erode and be swallowed in bits and pieces by the animal. But there's yet another factor: The amalgam placed in the sheep contained a higher proportion of mercury than that used in humans, giving it a softer, wetter consistency, like cake mix with too much water.

As a result, says one expert, when a sheep with radioactive amalgams was placed in a scanner, its gastrointestinal tract "lit up like a Christmas tree." The sheep were rapidly swallowing their fillings. But no one contends that people swallow fillings; the concern is over inhaled mercury vapor, not ingested mercury.

Moreover, experts doubt whether the sheep experienced any kidney damage at all. The changes reported in the animals' renal function were just the opposite of what happens

when kidneys are impaired, says Dr. Richard Malvin, a University of Michigan specialist in renal physiology who served on an ADA panel that reviewed the sheep study. For instance, damage to the kidney's filtering system typically causes blood levels of urea, a waste product, to rise. Instead, those levels fell, contradicting the researchers' claim of kidney damage.

More relevant to the issue of health effects on people are several recent population studies. In one, dentists with abnormally high concentrations of urinary mercury—attributable to occupational exposure—showed no evidence of kidney impairment on several key measures of renal function. Another study, which appeared in the March issue of the Journal of the American Dental Association, examined the claim that dental amalgam interferes with immune function. The researchers found that subjects with dental fillings had the same number of disease-fighting white blood cells as people who were amalgam-free. Similarly, a Swedish researcher found no differences between amalgam and nonamalgam groups in measures used to assess immune-system health, liver and kidney function, and skeletal-muscle status.

Finally, a study of 1024 Swedish women looked at the prevalence of 30 symptoms often claimed to reflect toxic effects of amalgam, including fatigue, dizziness, irritability, and back pain. Women with more than 20 fillings were no more likely to complain of these symptoms than women with few or no amalgams.

In fact, the only documented health effect associated with amalgams is the rare case of mercury allergy, thought to affect fewer than one in a million people. An allergic reaction to amalgam usually includes local rashes and swelling of the mouth, face, or neck area, and often improves without intervention.

Crunching the numbers

A major focus in the amalgam debate has been just how much mercury we get from our fillings. That's critical because "dose makes the poison," says toxicologist N. Karle Mottet, a professor of pathology and environmental health at the University of Washington School of Medicine. Usually harmless substances needed for survival—like vitamin A—can be toxic in very large doses, while known poisons are often harmless in tiny amounts.

Early estimates of our daily mercury dose from amalgams, based on the amount of vapor measured in the mouths of volunteers after vigorous gum-chewing, were alarmingly high. But they failed to account for real-life conditions that limit the actual dose—for instance, the amount of nose-breathing as opposed to mouth breathing, and the length of time spent chewing each day.

Standards set by the Occupational Safety and Health Administration estimate the mercury-vapor concentration to which even the most sensitive workers can be chronically exposed without suffering adverse effects. Under OSHA guidelines, the maximum "safe" occupational dose approximates roughly 300 to 500 micrograms per day, depending on physical activity. Current estimates predict that people with a moderate to large number of fillings are exposed to 1 to 3 micrograms of mercury vapor daily, or barely 1 percent of the dose considered safe.

Our exposure to mercury from dental amalgams is also less than our exposure from foods such as tuna and swordfish, which contain methyl mercury, a more toxic form.

Most important, amalgams contribute far less mercury to our total body burden—as estimated by blood and urine levels and confirmed in autopsies—than the levels at which toxic effects are seen. For instance, the lowest level at which neurologic symptoms (tremors, muscle weakness, fatigue) have been noted is 100 micrograms of urinary mercury per gram of urinary creatinine. Effects not noticeable to the individual, such as a slowdown in the speed of nerve conduction, have appeared between 25 and 100 micrograms of mercury per gram of creatinine. By contrast, very extensive amalgam restorations are associated with a maximum level of only 4 micrograms of mercury per gram of creatinine (see the chart on page 318).

"From all the studies I know, most people who aren't occupationally exposed just don't have a body burden of mercury associated with adverse health effects," says University of Washington toxicologist Mottet. Environmental-health experts recognize that susceptibility to toxic effects varies among individuals and that some groups are more sensitive than others. Nevertheless, there's no evidence that even potentially vulnerable populations, such as pregnant women and young children, are at any risk from the low levels of mercury vapor from amalgams.

If you want to check your own mercury status, your doctor can run mercury tests. Blood tests measure recent exposure and look for signs of toxicity, such as liver or kidney impairment. A 24-hour urine test shows chronic exposure, the type that would be associated with inhaling mercury vapor from amalgams. Urine levels above 25 micrograms per gram of creatinine may indicate mercury poisoning. Levels below 25 micrograms have not been associ-

Verboten in Germany? "60 Minutes" somberly reported that legislation in Germany to ban amalgam would be "passed within the year." But the Institute of German Dentists says no such law is even pending.

Banned in Paint

WHY NOT IN FILLINGS?

Last summer, the U.S. Environmental Protection Agency banned mercury from interior latex paints after finding dangerously high levels of mercury vapor in a few recently painted homes. That scare has passed, thanks to good compliance with the new regulation (see the report on latex paints, page 335). But amalgam opponents—a small but vocal group of scientists, dentists, and grass-roots organizers—have seized upon the episode as support for their claims. Why put something in our mouths that's harmful in our homes, they argue.

The reason is that dose makes the difference. The Government action followed an incident in which a four-year-old Michigan boy developed acrodynia, a rare form of mercury poisoning marked by rapid heartbeat, profuse sweating, peeling skin, and severe pain. The illness was tracked to fumes from mercury-containing latex paint, used in the boy's house 10 days before. A subsequent study found that people living in recently painted homes had urine mercury levels as high as 118 micrograms of mercury per gram of creatinine.

Symptoms from inhaled mercury vapor can begin at about the 100-microgram level, and the risk grows with increasing exposure. (See the chart on page 318.) By comparison, urine mercury levels attributable to extensive amalgam fillings top out at 4 micrograms of mercury per gram of creatinine, far below the levels linked to overt symptoms or subtle subclinical changes.

Body basics
Given low doses, the human body can rid itself of toxic agents such as mercury or render them harmless.

ated with any adverse effects, noticeable or otherwise.

Prospecting for diseases

Lacking a sound scientific foothold, anti-amalgamists have nonetheless come up with diagnostic measures other than blood and urine tests to convince patients to part with their fillings. One is the symptom questionnaire, a lengthy list of inquiries about skin problems, digestion, blood diseases, depression, insomnia, and other difficulties. Almost any symptom may be amalgam-related, say some dentists, "because mercury goes to all tissues and organs."

A favorite diagnostic tool in the 1980s was a skin patch test for mercury allergy or "hypersensitivity." Besides blurring the distinction between allergy—a specific immune reaction—and mercury poisoning, the test used a highly irritating dose of mercuric chloride. "It's like scratching your arm with a nail and concluding you're sensitive to nails," says Dr. Robert Baratz, an authority on the amalgam issue.

Then came the mercury-vapor detector, still widely used and also featured in the "60 Minutes" report, lending an aura of "science" to the measurement of mercury vapor in the mouth. The detector is designed to measure mercury fumes in the workplace, not in the mouth. Used in the mouth, it sucks up a small volume of air and multiplies the mercury level to estimate the amount present in a cubic meter of air. That allows dentists to compare the amount of mercury detected in a patient's mouth with permissible levels in the workplace. The results are usually alarming.

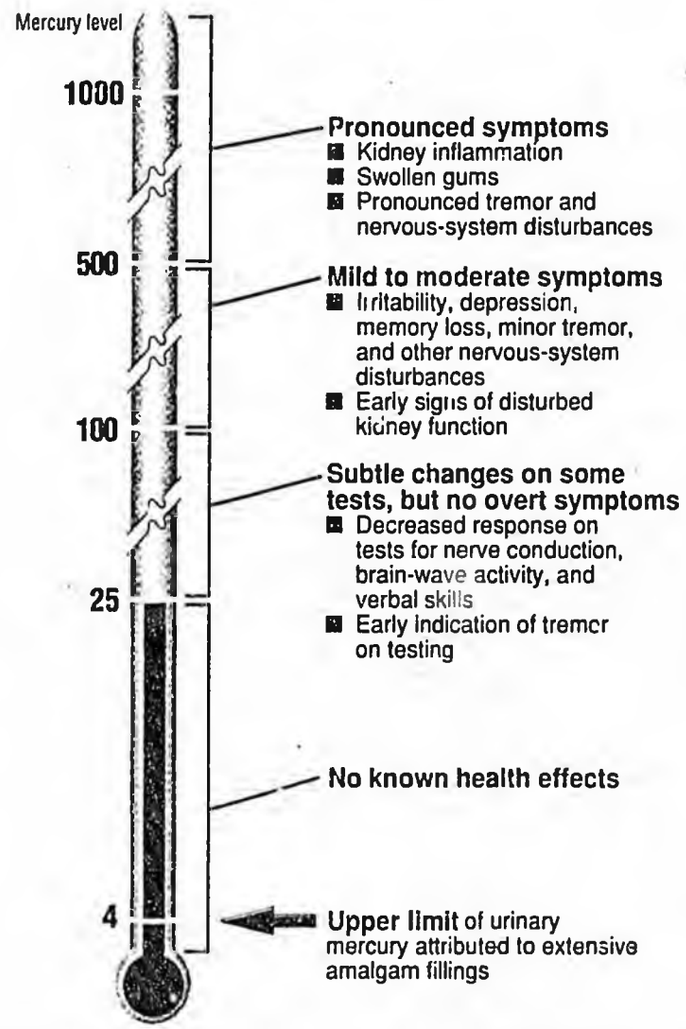
However, so are the flaws in this test. For one thing, the measurement is typically taken after 10 minutes of chewing, which maximizes the release of mercury vapor. But people chew only a few hours a day, at most, and inhale only a fraction of the vapor that's formed. Further, by measuring the air directly over a filling, the technique overestimates the mercury vapor in the rest of the mouth—an error that then becomes multiplied.

One thing amalgam opponents have gauged correctly is the power of speculation. Anyone with a chronic, baffling illness, such as rheumatoid arthritis or multiple sclerosis, could hardly ignore the possibility that mercury might be the key to the problem—or resist the hope that a simple cure was now possible. Others are worried that even the low levels released by amalgams might be hazardous in some way. Such speculation is behind the efforts of activists in Michigan, Illinois, and other states to pass informed-consent laws. The legislation would require dentists to inform patients of the possible hazards of mercury fillings, and to discuss alternatives to amalgam. The ADA opposes the laws because informed consent presumes the presence of risk. A risk from amalgam hasn't been demonstrated, even in pregnancy.

Although severe birth defects have occurred in cases of methyl mercury poisoning, none have been attributed to mercury vapor, especially at the low levels associated with amalgam. A study of 30,000 female dental assistants and the wives of 29,000 dentists, divided into high- and low-mercury exposure groups, found no difference between the two groups in the incidence of miscarriage or of birth defects in their offspring.

EFFECTS OF MERCURY VAPOR

The risk from mercury vapor depends on the amount and duration of exposure to it. A person's chronic exposure from all sources is reflected in the concentration of mercury excreted in the urine. If a problem is suspected, physicians can order a standard test for urinary mercury, with results expressed in micrograms of mercury per gram of creatinine. The chart below, also expressed in the same urinary measurement, provides an approximate gauge of typical health effects associated with various mercury levels.



But what about the dramatic recoveries reported by some people with migraines, multiple sclerosis, or other disorders after having their amalgams removed?

Recoveries reconsidered

"Ten anecdotes don't make one good experiment," notes University of Michigan physiologist Malvin. "Throughout history people have tried terrible 'cures' based on anecdote, from laetrile to bee stings." What appears to be a positive response to removing amalgams may actually be a placebo effect or spontaneous improvement in the course of the disease. Both are common in multiple sclerosis, rheumatoid arthritis, and other illnesses blamed on amalgam. Spontaneous remission of symptoms may sometimes last for several months or even years.

Some testimonials are suspect because the symptoms said to disappear are unrelated to any known effects of mercury poisoning. Other symptoms pinned on dental fillings, such as weakness, weight loss, and emotional changes, are indistinguishable from those of depression or other illnesses. And some claims—such as the woman crippled by multiple sclerosis who went dancing the night after her amalgams came out (featured on the "60 Minutes" segment)—are downright implausible. If a person regularly takes in more mercury than the body can excrete, the level in tissues increases slowly over time until symptoms of toxicity appear. Conversely, mercury is also eliminated from the body slowly, so it would take several months for symptoms to disappear. An overnight recovery indicates that something other than mercury was involved.

Notably absent among such testimonials (and from "60 Minutes") are the stories of countless people who've had their fillings out to no avail. Recently, an Iowa dentist was barred from practice for five years for advising a woman with multiple sclerosis to have her amalgams removed. Unable to pay $9000 to replace them with porcelain and gold, the woman had all her teeth extracted and replaced with dentures. A month later her illness worsened and she was hospitalized.

Dr. Thomas W. Clarkson, director of the Environmental Health Sciences Center at the University of Rochester, New York, and a leading authority on mercury toxicity, says the possibility that some people are unusually susceptible to the mercury in amalgams remains speculation. "There are diseases without any known cause, and it has to be left at that. To say that mercury is the cause of these diseases isn't reasonable. There's just not enough evidence for it."

Eyeing the options

The arguments in the amalgam debate come down to two opposing demands. Critics of amalgam want proof that it's safe; supporters want proof that there's a genuine hazard.

The ADA and other proponents are hoping a major study like the one envisioned by the National Institute of Dental Research will give a scientific stamp to their vast and positive experience with amalgam. But ultimately, "we can't prove anything is absolutely safe, not even drinking water," says Dr. John Stamm, dean of the University of North Carolina dental school in Chapel Hill.

Amalgam opponents view that uncertainty as an unacceptable risk. But all risks have to be measured against the alternatives. Amalgam has held sway for more than a century because it's strong and durable, able to withstand the tremendous pressures of chewing and grinding. It's also easy to place, relatively inexpensive, and has properties that protect against further decay.

The main alternative to amalgams are composite resin fillings—tooth-colored plastic materials that score high on cosmetic appeal. Although fine for front teeth, composites placed in back molars are slowly eroded by a combination of chewing stress and certain substances in food. Composites are also difficult to place precisely, and a poor fit can leave room for decay-producing bacteria. Newer formulations that chemically bond the composite to tooth enamel may overcome those problems, but the materials haven't been perfected. Composite fillings have been in only limited use for much of the last 20 years, and not enough experience has accumulated to assess whether long-term health problems may surface, according to Dr. J. Rodway Mackert Jr., associate professor of dental materials at the Medical College of Georgia.

Other amalgam alternatives include gold, which is very durable, and ceramic, which has a good appearance. However, both are expensive and have other drawbacks. (See the chart below.)

Removing amalgam in favor of an alternative material can be a risk in itself. With large fillings, the process can damage tooth structure and may injure the nerve, requiring a root-canal procedure. CU's dental advisors believe that, at present, the alternatives don't measure up. Given their solid track record and a risk that's still conjecture, amalgam fillings are still your best bet. ■

Cavities: not yet extinct
Despite great strides in prevention during the past two decades, half of all American schoolchildren still get cavities. The relatively low cost of amalgam fillings keeps dental care affordable for many families.

Reprints of this report will be available in bulk quantity. For information and prices, write CU Reprints Dept., 101 Truman Ave., Yonkers, N.Y. 10703-1057.

HOW DENTAL FILLINGS COMPARE

	Cost per filling [1]	Typical lifespan (years)	Visits to install	Matches tooth color	Resistant to wear	Risk of fracture	Increased risk of recurrent decay [2]
Amalgam	$51	10-20	1	No	Yes	Medium	No
Composite	64	3-10 [3]	1	Yes	No	Medium	Yes
Ceramic	404	10	2 or more	Yes	Yes [4]	High	Yes
Gold	361	20 or more	2 or more	No	Yes	Low	No

[1] *From CIGNA, national average charges for two-surface fillings*
[2] *Difficulty of achieving precise fit can leave room for re-entry of decay-producing bacteria.*
[3] *Based on limited data; lifespan of more than 5 years applies to small fillings only.*
[4] *Hardness of some ceramics tends to wear down opposing tooth.*

*by P.L. Fan, PhD

Safety of amalgam

Current analysis of scientific information indicates that amalgam restorations are safe

The trituration of mercury with an alloy for dental amalgam produces results in an amalgam restorative material that has a long-proven clinical performance record.

The formation of mercury-silver (gamma one) and mercury-tin (gamma two) phases are described in detail in dental materials textbooks. With the use of sensitive analytical instrumentation, investigators have reported that there were detectable nanogram amounts of mercury vapor in expired air of subjects after chewing.

This has stimulated extensive investigations and review of the safety of dental amalgam. This paper summarizes the positions on the safety of dental amalgam. It also discusses the Food and Drug Administration regulations on medical and dental devices used for diagnostic purposes.

Literature reviews

In 1982 a review by Bauer and First concluded that, "The use of mercury in dental amalgam is relatively safe. The potential for mercurial poisoning exists. However, its occurrence is negligible.

"Of concern to the dental patient and personnel is the occurrence of mercurial hypersensitivity, the allergic response to mercury in amalgam restorations and from restorative procedures. Since the allergic reaction is self-limiting, it may be necessary for the dentist only to be aware of its symptoms for an adequate diagnosis and palliative treatment."[1]

In 1987, Enwonwu, in a critical review of the literature on the potential hazards of use of mercury in dentistry, concluded that "while there is consistent evidence indicating release of mercury vapor from the restorations during chewing, tooth brushing, and other oral activities, proof of a casual link of this specific source of the heavy metal to any major human health problem is lacking."[2]

ADA

In 1983, the American Dental Association published a summary of scientific information then available.[3] It stated:

"There is no recorded scientific evidence of mercury vapor toxicity resulting from (10 ng/min) of mercury vapor. Further, none of these measured amounts of released mercury have been documented as being associated with various diseases or medical conditions, or both.

"Furthermore, and it is most significant to note that there is no documented scientific evidence to suggest that dentists and dental office personnel, who are exposed to much greater amounts of mercury vapor, have a greater incidence of certain medical conditions or higher mortality rates as compared with the general population."

The report also stated "the association wishes to emphasize that, except in individuals sensitive to mercury, there is no reason why a patient should seek to have amalgam restorations (silver fillings) removed. Indeed, the effect of such a procedure and further restorative operations could be detrimental to the patient's oral health, including the unnecessary loss of teeth, and cannot be justified."

Another report from the ADA[4] in 1984 considered the utilization and safety of patch testing for sensitivity to mercury and concluded that "patch tests for mercury. . .are not to be used indiscriminately for all patients. . .the validity of the patch test results and the suggested interpretation of the monitored patient reactions have not been well documented."

The report also stated that "a medical history of the patient and consideration of the benefit-to-risk should be included in the professional judgment on the use of patch tests. The decision rests with the dentist.

When a patch test is indicated, the informed consent of the patient should be obtained. Patch tests should only be performed by a professional trained in the administration and interpretation of these tests. Referral to physicians, such as allergists or dermatologists, who specialize in this testing is strongly recommended."

The ADA House of Delegates in 1986 passed a resolution on the use of amalgam as restorative material.[5] The resolution stated:

"Resolved that based on current documented scientific research, the conclusions of conferences and symposiums on the biocompatibility of metallic restorative material, and upon joint reports of the Council on Dental Materials, Instruments and Equipment and the Council on Dental Therapeutics of the Association, the continued use of dental amalgam as a restorative material does not pose a health hazard to the non-allergic patient, and be it further resolved that to advocate to a patient or the public the removal of clinically serviceable dental amalgam restorations solely to substitute a material that does not contain mercury is unwarranted and violates the ADA Principles

*Dr. Fan is associate secretary, American Dental Association's Council on Dental Materials, Instruments and Equipment.

of Ethics and Code of Professional Conduct, and be it further resolved that in those instances where state dental boards initiate proceedings on this question that the ADA cooperate in such proceedings by making available scientific personnel as expert witnesses."

NIDR

The National Institute of Dental Research (NIDR), in 1984, sponsored a workshop on biocompatibility of metals in dentistry.[6-10] The goal was to review existing scientific evidence and literature about metals used in dentistry and to pinpoint areas of interest or concern that warrant further research. The question as to whether the small levels of mercury released from amalgam surfaces can pose a possible risk for patients with amalgam restorations was also considered.

The summary on the workshop stated:

"Studies have demonstrated that patients are exposed to mercury vapor when amalgams are placed as a restoration, when existing amalgams are removed, and during chewing.

"Some studies suggest that blood levels of mercury are elevated in patients during these procedures and that the levels are correlated with the number of amalgams and the occluding surface area. Other studies have shown no difference in blood levels in patients with and without amalgam restorations. Additional studies in this area are required to more accurately assess the possible risk to patients.

"Health hazards of blood mercury levels associated with dental amalgams have not been documented. It is difficult, therefore, to interpret the relevance of blood and urine levels of mercury that are observed after placement or removal of amalgams, and chewing on amalgam surfaces. In addition, the distribution of mercury into body tissues is highly variable and there appears to be little correlation between levels in urine, blood or hair, and toxic effects."

The summary also addressed the consideration of rare occurrences of possible allergic reaction to mercury and states that "although cases of allergy to mercury have been reported in the literature, the prevalence of mercury allergy is estimated to be less than 1 percent.

"In patients with a history or clinical symptoms (or both) of mercury allergy, patch testing may be indicated to confirm the allergy. Because of the infrequency of reports of mercury allergy, it is not recommended that patients be tested routinely for sensitivity.

"When patch testing is indicated, it is recommended that the patient be referred to a professional trained in the administration and interpretation of the test."

The conclusion of the workshop is stated in the summary: "On the basis of the information presented in this workshop, there is no documented evidence for recommending the discontinuation of the use of dental amalgams as a restorative material in dentistry. Additionally, the removal of dental amalgam can be recommended only in those patients who have a true hypersensitivity to mercury or other constituents."

USPHS

The United States Public Health Service (USPHS), in 1984, issued a statement on the safety of dental amalgam.[11] The statement, signed by the Assistant Surgeon General, Dr. Robert E. Mecklenburg, put forth the position that "Research on dental amalgam, as well as the total range of dental restorative materials used in the United States and accepted by the U.S. Food and Drug Administration and the American Dental Association's Council on Dental Materials, indicates no potential harm to the vast majority of dental patients receiving amalgam fillings.

"Additionally, no evidence exists to indicate that the health of individuals occupationally exposed to dental amalgams (dentists, dental hygienists, dental assistants) is compromised where approved materials and methods are conscientiously employed.

"As with any substance, the rare possibility of individual allergy does exist. However, individuals suspected of having such allergies may receive skin tests and, where necessary appropriate dental treatment alternatives can then be selected.

"Individuals should not seek replacement of amalgam fillings with alternate materials based on a fear of harm. To do so would result in unnecessary expenditures. Providers of dental care should be familiar with accurate scientific literature as well as the actions and recommendations of representative professional organizations, such as the American Dental Association, regarding dental restorative materials, and should not discontinue appropriate use of dental amalgam."

NMSS

The use of amalgam as a restorative material has been implicated by some as the cause of a number of medical problems such as neurological diseases and more specifically, multiple sclerosis (MS).

In response to this specific implication, the National Multiple Sclerosis Society (NMSS) issued a memorandum in 1983 to refute this implication.[12] The memorandum said:

"A review of the literature reveals that the question of mercury toxicity from silver fillings was raised in Europe in the mid-1960s by a Swiss neurologist, Ernst Baasch. However, later publications from the same area and during the same decade show the seemingly contradictory recommendation for the use of mercury as part of a salve compound to treat MS cutaneously.

"(This indicates the complex and inconclusive nature of these claims, and the difficulties faced when evaluating the theories which abound, concerning the causes of, and treatments for, multiple sclerosis.)

"There has been a related suggestion that a combination of gold and silver fillings in contact with saliva can create an 'electrogalvanic current' which adversely affects the cells of the body, causing neurological dysfunction. This claim is also questionable, as there are vast numbers of people with mixed dental metals, and there is no documentation of any adverse effects.

"Although the claim that removal of silver amalgam and replacement with alternative dental materials will alleviate the symptoms or cure neurological disease is based partly on the known toxicity of heavy metals, the toxic effects of mercury absorption occur only when this agent is in the form of elementary mercury vapor or as mercury compound dusts. The 'occasional incidental swallowing of metallic mercury is without harm' (Merck Index, 1976).

"If indeed there was a connection between silver amalgam dental fillings and multiple sclerosis, one might observe a much higher incidence of MS among the professional dental community, as well as

Continued on Page 36

among those who assist dentists. These individuals deal with mercury in its more elemental form and theoretically are exposed to greater risk.

"There is no indication that a higher incidence of MS exists among this specialized group. In addition, the incidence of multiple sclerosis has been documented in the literature long before modern techniques of dentistry were developed and thus it would be impossible to implicate dental amalgam in any of those cases.

"Several other factors need to be seriously appraised in relation to this therapeutic claim. First, there is a placebo response as high as 70 percent in patients with multiple sclerosis which makes defining the basis for improvement in any individual patient impossible unless subject of rigorously controlled trials.

"Second, while the effect of stress on the clinical course of multiple sclerosis can never be predicted in any specific instance, it is the consensus of experienced physicians that avoidance of unnecessary physical or emotional stress is an important consideration in maintaining optimal function. Such stress includes unnecessary surgery and anesthesia.

"Finally this therapeutic claim for multiple sclerosis involves economic implications, in terms of expense to the patient and great profit to the dentist.

"In evaluating this treatment, patients should recognize all of these issues and are advised to consult their physician before pursuing this dental therapy. It is the advice of the National Medical Advisory Board that replacement of silver amalgam fillings cannot be recommended for the treatment of multiple sclerosis."

Consumers Union

The Consumers Union investigated "the mercury scare" and reported its findings in a 1986 article.[13]

Its reporter visited a dental office and after undergoing a saliva test and a test for mercury vapor emission after chewing, was advised to have the fillings out by 9 o'clock that night at a cost of $580. The reporter then visited the office of Consumer Union's chief medical consultant and provided a blood sample and a urine sample for mercury testing.

The acidity of the saliva was also tested. The reporter also consulted with Dr. Clarkson of the University of Rochester School of Medicine, who is one of the world's leading authorities on mercury toxicity.

When the reporter notified Dr. Clarkson of the test results, the advice from Dr. Clarkson was that the reporter should hold on to his $580. The Consumers Union's view is stated in the article as "dentists who purport to treat health problems by ripping out fillings are putting their own economic interests ahead of their patients' welfare.

"Amalgam has been used for more than 150 years. Except for a few people with a genuine allergy to mercury, Consumers Union knows of no one who has been harmed by them. There is little danger of the U.S. becoming a nation of Mad Hatters."

FDA

The use of mercury vapor analysers or galvanic current meters as diagnostic devices for toxicity or allergy would place these items under the categories of medical and dental devices.

Government regulations require that medical and dental devices need to be approved for marketing before they are commercially available. The agency responsible for approving these devices is the Center for Devices and Radiological Health, Food and Drug Administration.

This agency can remove unapproved medical and dental devices from the market. This has been the case for an amalgameter.

Conclusions

The current analysis of scientific information indicates that amalgam restorations are safe. Exceptions may be the rare individuals who are allergic to mercury.

The incidence of mercury allergy is so rare that a percentage number cannot be assigned to its occurrence in the general public. Routine allergic testing to mercury should not be performed. If an allergy test is to be considered, the administration and interpretation by a professional trained in these areas are recommended.

There is no scientific basis to consider mercury from amalgam restoration is a causative factor for medical problems, especially neurologic diseases such as multiple sclerosis.

Apart from demonstrated allergic reactions, there is no reason for patients to have amalgam restorations removed. The practitioner should be aware that diagnostic systems are regulated by the Food and Drug Administration.

References

1. *Bauer, J.G.; and First, H.A.: "The toxicity of mercury in dental amalgams."* CDAJ. *10(6):47-61, 1982.*
2. *Enwonwu, C.O.: "Potential health hazard of use of mercury in dentistry: critical review of the literature."* Environmental Res. *42:257-274, 1987.*
3. *Council on Dental Materials, Instruments and Equipment; and Council on Dental Therapeutics: "Safety of dental amalgam."* JADA. *106:519-520, 1983.*
4. *Council on Dental Materials, Instruments and Equipment; and Council on Dental Therapeutics: "Patch tests for sensitivity to mercury or nickel."* JADA. *108:381, 1984.*
5. *American Dental Association, Transactions 127th Annual Session, Miami Beach, Florida, 1986, p. 536-537.*
6. *National Institute of Dental Research: "Workshop: biocompatibility of metals in dentistry."* JADA. *109:469-471, 1984.*
7. *Mitchell, E.W.: "The biocompatibility of metals in dentistry."* CDAJ. *12(10):17-19, 1984.*
8. *Autian, J.: "Carcinogenic potential of metals."* CDAJ. *12(10):23-33, 1984.*
9. *Cooley, R.L.; and Young, J.M.: "Detection and diagnosis of bioincompatibility of mercury."* CDAJ. *12(10):36-43, 1984.*
10. *Svare, C.W.: "Dental amalgam related mercury exposure."* CDAJ. *12(10):54-60, 1984.*
11. *U.S. Public Health Service Statement on the Safety of Dental Amalgam, April 30, 1984.*
12. *National Multiple Sclerosis Society, Patient Services Department Memorandum No. 115-83, Silver amalgam fillings and multiple sclerosis.*
13. *Consumers Union: "The mercury scare."* Consumers Report. *51:150-152, 1986.*

Reprint requests to
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TALK PAPER

FOOD AND DRUG ADMINISTRATION
U.S. Department of Health and Human Services
Public Health Service 5600 Fishers Lane Rockville, Maryland 20857

T91-15
March 20, 1991

Susan Cruzan
(301) 443-3285

FDA Panel Considers Safety of Dental Amalgams

FDA's Dental Devices Panel met today to discuss recent research and patient case reports related to the possible hazards associated with dental amalgam fillings. The panel was asked to address whether the mercury in amalgam fillings can pose a risk to patients and to advise the agency on the types of studies needed to further assess the safety of these devices.

The following may be used to respond to questions.

Several clinicians, patients, researchers, manufacturers and organizations, including the American Dental Association and the National Institute for Dental Research, expressed their views on possible hazards and research needs in this area. The panel reviewed recent animal studies and human case reports which have raised questions about the continued use of these devices.

The panel concluded that none of the data presented shows a direct hazard to humans from dental amalgams. However, the panel agreed that the studies presented did raise questions that warrant further research. The panel recommended that FDA establish a special working group to identify the kinds of animal and human studies needed to answer the question of amalgam safety. This group would work in collaboration with other research organizations such as the National Institute for Dental Research.

The panel's recommendations are not binding, but FDA will take them under consideration. FDA agrees with the panel that additional research is

-MORE-

needed to resolve unanswered questions about amalgam safety. In the months to come, FDA will decide on the best means of assuring that this research is undertaken.

In the meantime, FDA does not advise that individuals ask dentists to remove their amalgams. FDA agrees with the advisory panel that there is no valid data to demonstrate clinical harm to patients from amalgams, or that having them removed will prevent adverse health effects or reverse the course of existing diseases.

Dental amalgams, a mixture of silver and mercury, have been used for over 150 years. The mercury allows the amalgam to flow smoothly into the dental cavity. This material is ideal for cavities because it adheres tightly to the cavity, sets up hard and resists abrasion.

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Official Business

COMMITTEE:
SENATE HESS

DATE: May 3, 1991

Subject of meeting:
SB 123 - INFORMED CONSENT FOR DENTAL FILLINGS

SIGN-IN

PLEASE PRINT!

NAME	ADDRESS (MAILING) & (ZIP)	PHONE	REPRESENTING	DO YOU WANT TO TESTIFY?
Ann Boudreaux	DCED OCC LIC		Occupational Licensing	Yes
Mike McKrill	SEE 1st sheet		Dentistry	YES
Robert Robinson	SEE		Dentistry	YES

SB

125

Alaska State Legislature

Senator Curt Menard

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Senate District E

TO: Senator Arliss Sturgulewski
Chair - Senate Health, Education and Social Services Committee

FROM: Senator Curt Menard

DATE: March 25, 1991

RE: Additional packet materials for:
SB 125: "An Act relating to pharmacies located outside of the state"

Thank you for scheduling a public hearing on the above referenced bill. Please find attached additional information for the committee packets.

1. Letter of support: Alaska Pharmaceutical Association
2. "Seniors: More drug use, more adverse reactions" Senior Voice, April 1990
3. Letter of support for 1990 bill [HB 508]: Legal counsel for Medco Containment Services
4. Letter from Dept. of Administration regarding 1990 bill [HB 508]: Legislation will not effect state health insurance plan
5. Research dated January 26, 1990
6. Research dated February 6, 1990
7. Suggested amendments to SB 125

Alaska State Legislature

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Senate District
E

TO: Senator Arliss Sturgulewski
Chair - Senate Health, Education and Social Services Committee

FROM: Senator Curt Menard

DATE: March 7, 1991

RE: SB 125 "An Act relating to pharmacies located outside of the state"

I am writing to request that the above referenced bill be scheduled for a hearing before the Senate Health, Education and Social Services Committee at your earliest convenience.

There is a growing number of mail order pharmacies doing business in the state who are not accountable to their Alaskan customers. SB 125 addresses this consumer protection problem and provides reassurance to Alaskans who rely on those services.

This legislation requires any pharmacy located outside of the state that ships, mails, or delivers prescription drugs into Alaska on a routine basis to register with the Alaska State Board of Pharmacy. In order to register the pharmacy must provide specific documents that indicate compliance with licensing requirments in their home jurisdiction. The bill sets reasonable standards of disclosure to the Alaska Board of Pharmacy.

The most important requirement of this bill is the provision for out of state pharmacies to provide a toll free telephone services at least 40 hours a week and at least six days a week. When questions or problems resulting from prescription medication arise, it is imperative that the customer or medical responder be able to contact the dispensing pharmacist.

This legislation provides important measures to protect the health, safety and welfare of Alaskan consumers. Your support is greatly appreciated.

WE SUPPORT
MADE IN ALASKA

7-LS0713\A.1
Bannister
03/22/91

AMENDMENT

OFFERED IN THE SENATE

BY SENATOR MENARD

TO: SB 125

Page 1, line 5:

Following "that":

Insert "regularly"

Following "drugs":

Delete "into"

Insert "to consumers in"

Page 2, line 14, following "state":

Insert "and subject to this section"

Page 2, line 18, following "that":

Insert "is subject to this section but"

Page 2, following line 29:

Insert a new subsection to read:

"(g) The board shall by regulation define "regularly" for this section."

Page 3, line 5:

Delete "other than a nonprescription drug"

Insert "that requires a physician's prescription before it may be dispensed"