Safe Amalgam Removal Online Learning Activity Script

International Academy of Oral Medicine and Toxicology (IAOMT); www.iaomt.org
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PREFACE TO IAOMT'S SAFE AMALGAM REMOVAL ONLINE LEARNING VIDEO ACTIVITY

Text on screen:

Welcome to IAOMT's Safe Amalgam Removal Online Learning Video Activity. The "Materials" tab above this video, as well as the text box below this video, contain links to references and resources cited in this activity, scientific literature related to the topics presented, and a script for this entire video. The successful completion of a quiz at the end of this activity is required for individuals participating in an IAOMT course.

In offering this activity, the IAOMT's intention is to present as much scientific information as possible on different dental materials, treatments, patient and dental staff safety, and other aspects of dentistry.

The objective of the Safe Amalgam Removal Online Learning Video is that at the conclusion of this activity, participants will be able to recognize scientifically supported recommendations for minimizing mercury exposure during amalgam filling removal.

The IAOMT emphasizes that health care practitioners must make their own professional judgments for the benefit of themselves and their patients and staffs. You are responsible for exercising your own judgment concerning the specific treatment options to utilize in your practice; for complying with applicable laws and regulations including local dental practice acts and informed consent requirements; and for abiding by insurance requirements including written declarations of coverage.

Only proceed if you understand and agree with these statements.

If you are ready to proceed, the activity will begin with Tammy DeGregorio, DMD, NMD, AIAOMT, providing you with the coursework for this Safe Amalgam Removal Online Learning Video Activity.

INTRODUCTION

Dentists who engage in elective replacement of amalgam fillings have often been criticized by their peers for unnecessarily exposing their patients to excess mercury during the process of grinding the old fillings out. Yet, the mercury free dentists are the ones who are the most critically aware of the mercury exposure problem.

In safe removal of amalgam fillings, we present scientifically verified procedures for minimizing mercury exposure. These are procedures that all dental office personnel should learn and follow for their own protection, and for the protection of their patients.

Even if all the dentists in the world were to stop placing amalgam fillings today, the need to drill out and remove old fillings would remain with us for generations. While some of the mercury fillings that exist in people's mouths today will go to the grave with them, a high percentage will need to be replaced for maintenance purposes. Some, we expect, will be removed electively, as people seek to eliminate that source of mercury exposure for themselves.

Everyone involved, including dental patients, dentists, and dental staff, need to be aware of the many hazards in removing old mercury fillings, as well as the hazards and responsibilities of dealing with the waste.

MERCURY VAPOR MEASUREMENT VIDEO

Insert video:

SMART Mercury Vapor Measurements: **https://youtu.be/fjJWkcoGdnc**

OUR SUGGESTIONS AND YOUR TREATMENT OPTIONS

A great many dentists around the world have already stopped placing amalgam fillings, for a variety of reasons: aesthetics, patient demands, recognition of the advantages of bonded restorations, and legitimate concerns about a mercury exposure. But a very few understand the enormous amount of mercury exposure created by the act of drilling them out. Few realize the importance of taking steps to reduce the source of toxic exposure for themselves, their patients, the dental staff, and the environment.

The methods available for mitigating mercury exposure when removing amalgam fillings can readily be implemented by any modern dental facility. Please keep in mind that the various methods recommended in this course are presented as a set of suggestions. Licensed practitioners must make up their own minds concerning specific treatment options.

Screen to the right:

- The methods recommended are a set of suggestions.
- Licensed practitioners must make up their own minds as to specific treatment options.

EARLY LITERATURE ON AMALGAM FILLING REMOVAL AND MERCURY EXPOSURE

The old dental literature contains many references to systemic mercury exposure when amalgam fillings are removed with no precautions. For example, the paper by Snapp in 1989 shows a mean doubling of blood mercury and dental patients one week after unprotected

removal of mercury fillings. It took between 2 and 5 months for these patients to return to baseline levels of blood mercury. This is the reason why there are so many anecdotes of people who report feeling sick after amalgam replacement, and the spike in mercury exposure is what we must work to eliminate.

Screen to the right:

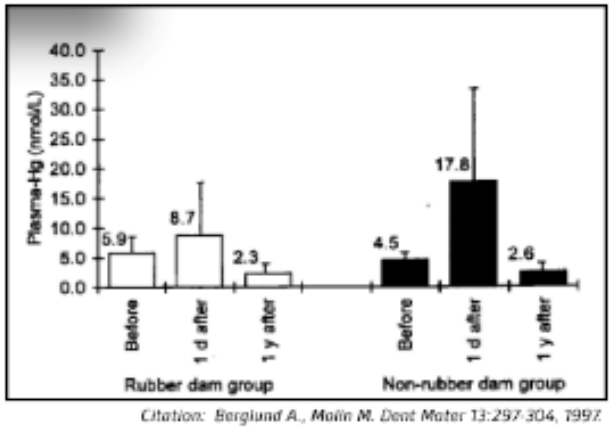
pre-removal	1 week post	percent increase
1.63	2.82	173.01
1.44	4.1	284.72
2.98	7.1	238.26
1.93	2.93	151.81
2.02	5.7	282.18
4.09	6.34	155.01
2.92	3.45	118.15
1.55	2.72	175.48
	mean increase	197.33
ng Hg/ml in whole blood		

Citation: Snapp, et al, J. Dent Res 68(5): 780-785, 1989

Snapp KR, Boyer DB, Peterson LC, Svare CW. The contribution of dental amalgam to mercury in blood. Journal of Dental Research. 1989 May;68(5):780-5.

On the other hand, this graph from a paper by Berglund and Molin, from 1997, showed how simply using a rubber dam can greatly reduce systemic mercury exposure in the immediate aftermath of amalgam replacement period.

Screen to the right:



Citation: Berglund A., Molin M. Dent Mater 13:297-304, 1997

Berglund A, Molin M. Mercury levels in plasma and urine after removal of all amalgam restorations: the effect of using rubber dams. Dental Materials. 1997 Sep 1;13(5-6):297-304.

MERCURY PARTICULATE FROM DRILLING AMALGAM FILLINGS

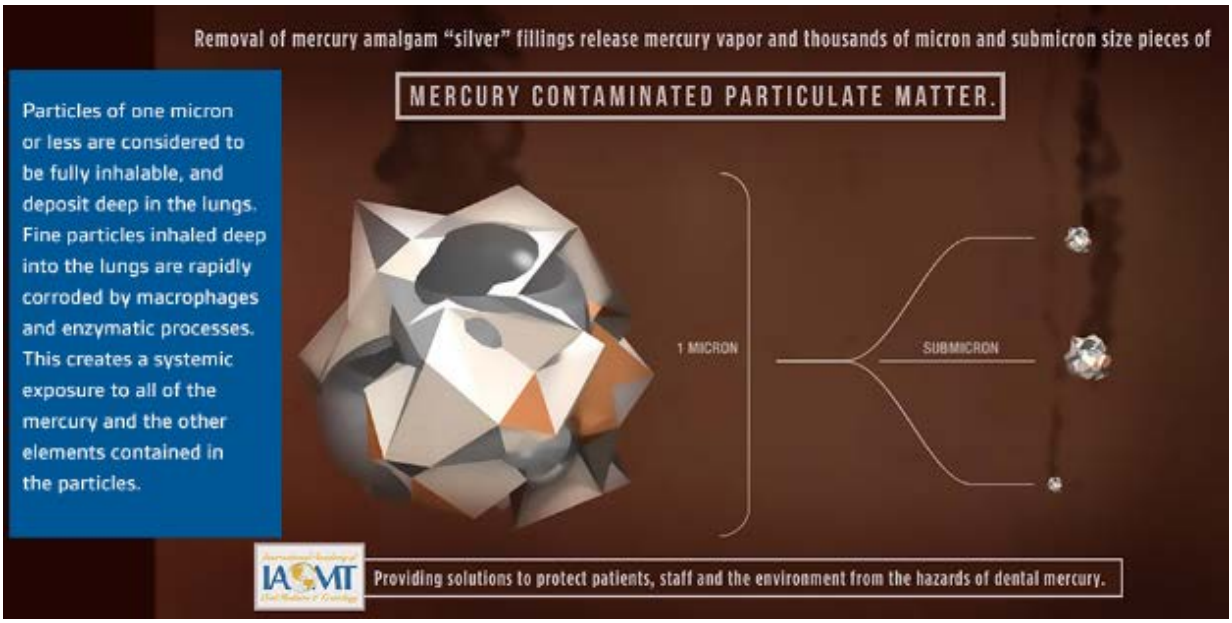
The rate of mercury vapor evaporation from amalgam is a function of both the temperature in the surface area. Whenever we drill an amalgam filling, we effectively mill it into micron-sized particles. This vastly increases its surface area and therefore its rate of mercury evaporation. Far more of the mercury content of the drilled-out filling resides in the particulate we generate than in the vapor. Micro-fine particles are a much more active source of metallic mercury evaporation than a bulk body of the old filling.

Screen to the right:

- Volatilizable particulate is a far greater source of mercury than vapor.
- 65% of the particles are smaller than one micron.

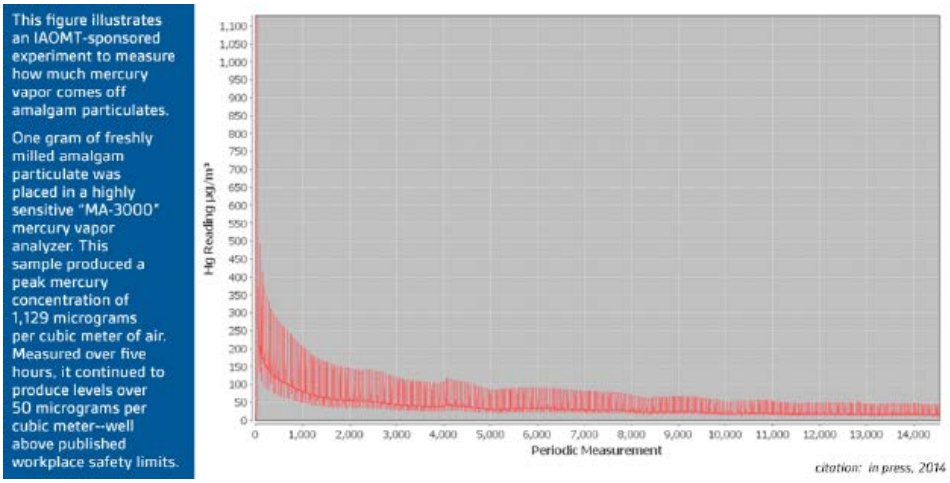
Particles of one micron or less are considered to be fully inhalable, and deposit deep in the lungs. Fine particles inhaled deep into the lungs are rapidly corroded by macrophages an enzymatic process. This creates a systemic exposure to all of the mercury and the other elements contained in these particles.

Infograph on screen:



This figure illustrates an IAOMT-sponsored experiment to measure how much mercury vapor comes off amalgam particulates. One gram of freshly milled amalgam particulate was placed in a highly sensitive "MA-3000" mercury vapor analyzer. This sample produced a peak mercury concentration of 1,129 micrograms per cubic meter of air. Measured over five hours, it continued to produce levels over 50 micrograms per cubic meter-- well above published workplace safety limits.

Figure on screen:



Palmer J, Young M, Warwick D. Efficacy of the IAOMT Engineering Controls Used During Removal of Mercury Silver Dental Restorations. IAOMT Scientific Review. 2014.

ENGINEERING CONTROLS FOR AMALGAM REMOVAL

As old fillings are drilled out, the mercury vapor diffuses through the air and the particular cloud spreads radially around the operatory environment. With as much exposure as this generates, we must look for methods that will reduce the dispersion mercury around the room and reduce the mercury exposure to everyone present. Methods that can be used to reduce a toxic exposure in the workplace are referred to as “engineering controls.”

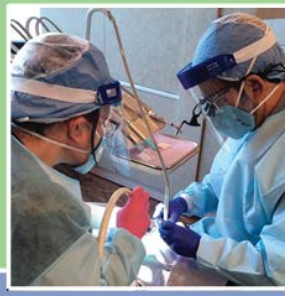
Material on screen:

These are the SMART safety measures for patient protection:

- Slurry of charcoal, chlorella, or similar adsorbent
- Full body, impermeable barrier
- Full head/face/neck barrier
- External air or oxygen delivered via a nasal mask
- Dental dam made with non-latex nitrile material
- Saliva ejector
- At source oral aerosol vacuum
- Clean Up device (not essential but preferred)
- Copious amounts of water
- Conventional high speed evacuation device
- Section amalgam into chunks and remove in large pieces

These are the SMART safety measures for dentist and dental staff protection:

- Protective gowns and covers
- Non-latex nitrile gloves
- Face shields and hair/head coverings
- Either a properly-sealed, respiratory grade mask rated to capture mercury or a positive pressure, properly-sealed mask providing air or oxygen
- During the opening and maintenance of suction traps, dental staff should utilize the appropriate personal protection equipment



WARWICK ET AL. 2019 STUDY ON DRILLING AMALGAM FILLINGS

How much mercury really gets spread around when we drill out an old filling? A team of investigators affiliated with IAOMT set out to answer this question.

Insert video:

> New Study Quantifies Mercury Releases from Amalgam during Drilling: https://youtu.be/k61KTRmBAN8

APPLICATION OF THE SAFE MERCURY AMALGAM REMOVAL TECHNIQUE (SMART)

Our obligation as dentists is to prevent our patients from breathing, swallowing, and having skin contact with the mercury-laden debris that's generated when we remove their old amalgam fillings. We know that taking such care by using simple, basic, physical barrier techniques will substantially reduce the exposure the patient receives. Employing these protective measures, we proceed with our new restorative procedures once we know the risk of mercury exposure is past.

Which amalgam fillings do we recommend these procedures for? All of them!

Insert video:

> SMART Recommendations: https://youtu.be/AO_6W-Hnt64

OCCUPATIONAL MERCURY EXPOSURE AND DENTISTRY

The other side of the amalgam mercury exposure problem involves the dentist and dental staff, who can frequently be exposed to high levels of mercury on the job.

Why do dental authorities continue to claim that dentists who use mercury are no unhealthier than the general population? How can they, when exposure limits are exceeded in the literature is full of reports of mercury related illnesses in dental workers who handle amalgam?

Text on screen:

Occupational Exposure Limits

Most nations recognize an occupational exposure limit of either 25 or 50 micrograms of mercury per cubic meter of air, as an average over an 8-hour workday, and 100 micrograms as a top limit for momentary exposures.

Some typical mercury exposures that have been reported to occur in the dental operatory are shown in this table:

OSHA Hg Limit=
Not to exceed 100 ug/m3

- **Opening an amalgam capsule** 400 ug/m3
- **Opening chair-side trap** 600 ug/m3
- **Drilling with no water spray** 1200 ug/m3
- **Drilling with water** 100 - 460 ug/m3
- **Drilling with water and suction** 15 - 40 ug/m3
- **Polishing (Prophy)** 500 - 900 ug/m3

2019 Publication about Mercury Filling Removal and Drilling Exposure by IAOMT Members

- Published in the peer-reviewed *Journal of Occupational Medicine and Toxicology (JOMT)*
- Shows that the safety thresholds for mercury exposure can be exceeded during dental procedures involving drilling on amalgam fillings if special precautions are not in place
- Further indicates that standard methods appear to be inadequate when assessing mercury exposure during drilling on dental amalgam because these methods do not account for an overlooked source: mercury vapor emitted from particles of the filling that are generated by drilling
- Also emphasizes that specific safety measures can mitigate these mercury levels and provide more rigorous protection for patients and dental workers

Research | Open Access | Published: 17 July 2019

Mercury vapor volatilization from particulate generated from dental amalgam removal with a high-speed dental drill – a significant source of exposure

David Warwick ✉, Matt Young, Joe Palmer & Robin Warwick Ermel

Journal of Occupational Medicine and Toxicology 14, Article number: 22 (2019) | Cite this article

4446 Accesses | 78 Altmetric | Metrics

Warwick D, Young M, Palmer J, Ermel RW. Mercury vapor volatilization from particulate generated from dental amalgam removal with a high-speed dental drill–a significant source of exposure. *Journal of Occupational Medicine and Toxicology*. 2019;14(1):22.

Dental Students Are Also at Risk

STUDY: Warwick R, O Connor A, Lamey B. Mercury vapour exposure during dental student training in amalgam removal. *J Occup Med Toxicol*. 2013; 8(1):27.

QUOTE: "It is paramount that dental schools consider how dental students are trained in the subject of mercury hygiene when removing dental amalgam as well as other procedures where mercury exposure may occur. They must also train dental students in the effective use of personal protective equipment in order to prevent occupational exposure to mercury while in dental school and in clinical practice."

Sampling of Additional Research Documenting Dangers to Dental Workers

These are a few of the research articles reporting higher levels of mercury in dental workers:

- Kasraei S, Mortazavi H, Vahedi M, Vaziri PB, Assary MJ. Blood mercury level and its determinants among dental practitioners in Hamadan, Iran. *Journal of Dentistry (Tehran, Iran).* 2010;7(2):55.
- Tezel HÜ, Ertas OS, Ozata FE, Erakin C, Kayali A. Blood mercury levels of dental students and dentists at a dental school. *British Dental Journal*. 2001 Oct;191(8):449-52.
- Ritchie KA, Gilmour WH, Macdonald EB, Burke FJ, McGowan DA, Dale IM, Hammersley R, Hamilton RM, Binnie V, Collington D. Health and neuropsychological functioning of dentists exposed to mercury. *Occupational and Environmental Medicine*. 2002 May 1;59(5):287-93.
- Langworth S, Sällsten G, Barregård L, Cynkier I, Lind ML, Söderman E. Exposure to mercury vapor and impact on health in the dental profession in Sweden. *Journal of Dental Research.* 1997 Jul;76(7):1397-404.

This research showed that dentists used many more prescriptions for conditions that are associated with mercury toxicity: 7.5 times the number of prescriptions to control neurological conditions, and significantly more drugs for respiratory and coronary diseases than non-dentists.

- Duplinsky TG, Cicchetti DV. The health status of dentists exposed to mercury from silver amalgam tooth restorations. *International Journal of Statistics in Medical Research*. 2012 Oct 2;1(1):1-5.

Dentists had increased skin hyperpigmentation, respiratory disorders, irregular pulse, hand tremors, spasms of the upper extremities, neuro-psych symptoms, tachycardia, painful chewing, thyroid enlargement, fears and difficulty in writing.

- Neghab M, Choobineh A, Zadeh JH, Ghaderi E. Symptoms of intoxication in dentists associated with exposure to low levels of mercury. *Industrial Health*. 2011;49(2):249-54.

Neurological issues such as memory loss, concentration issues, fatigue, and sleep disturbances related to working with mercury amalgam are discussed in these works.

- Mutter J. Is dental amalgam safe for humans? The opinion of the scientific committee of the European Commission. *Journal of Occupational Medicine and Toxicology*. 2011 Dec 1;6(1):2.
- Moen BE, Hollund BE, Riise T. Neurological symptoms among dental assistants: a cross-sectional study. *Journal of Occupational Medicine and Toxicology*. 2008 Dec 1;3(1):10.

Pregnant dental staff “suffered higher odds of developing spontaneous abortion and pre-eclampsia and giving birth to babies smaller for gestational age.”

- El-Badry A, Rezk M, El-Sayed H. Mercury-induced oxidative stress may adversely affect pregnancy outcome among dental staff: a cohort study. *The International Journal of Occupational and Environmental Medicine*. 2018 Jul;9(3):113.

Results from 13,906 dentists suggest “a positive association between Hg(0) exposure and tremor."

- Anglen J, Gruninger SE, Chou HN, Weuve J, Turyk ME, Freels S, Stayner LT. Occupational mercury exposure in association with prevalence of multiple sclerosis and tremor among US dentists. *Journal of the American Dental Association*. 2015; 146(9):659-68.

Researcher who is an expert on risk assessment concludes that “dentists' occupational exposure should also be considered as a justification for reduced amalgam use.”

- Richardson GM. Inhalation of mercury-contaminated particulate matter by dentists: an overlooked occupational risk. *Human and Ecological Risk Assessment*. 2003; 9(6):1519-1531.

Authors state, "Symptoms from the central nervous system are among the health problems that most often are attributed to Hg exposure in dentists and dental nurses working with amalgam. Uncharacteristic symptoms of chronic low-level Hg vapor exposure including weakness, fatigue, and anorexia have been observed in numerous studies of dental personnel."

- Aaseth J, Hilt B, Bjørklund G. Mercury exposure and health impacts in dental personnel. *Environmental Research*. 2018 Jul 1;164:65-9.

Researchers of this study linked the polymorphism CPOX4 (coproporphyrinogen oxidase, exon 4) to decreased visuomotor speed and indicators of depression in dental professionals.

- Echeverria D, Woods JS, Heyer NJ, Rohlman D, Farin FM, Li T, Garabedian CE. The association between a genetic polymorphism of coproporphyrinogen oxidase, dental mercury exposure and neurobehavioral response in humans. *Neurotoxicology and Teratology*. 2006; 28(1):39-48.

Researchers conclude their review "reveals a significant occurrence of neurological and sensory symptoms in dental workers occupationally exposed to chronic, low levels of metallic Hg."

- Bjørklund G, Hilt B, Dadar M, Lindh U, Aaseth J. Neurotoxic effects of mercury exposure in dental personnel. *Basic & Clinical Pharmacology & Toxicology*. 2019 May;124(5):568-74.

OSHA AND DENTAL MERCURY EXPOSURE

Regulations and best practices that protect employees from exposure to pathogens also apply to mercury exposure. Employee exposure is strictly regulated in the US. Employers must provide training in popper handling toxic substances in methods for personal protection and maintain records of that training.

Text on screen:

OSHA and Safety Data Sheets

Employee exposure to mercury is regulated in the United States by the 1970 Occupational Safety and Health Act and Workers' Rights Handbooks from the United States Department of Labor's Occupational Safety and Health Administration (OSHA), which establish that all employees have the right to know about the chemicals in their work environment.

OSHA's Hazard Communication Standard (HCS) states: "All employers with hazardous chemicals in their workplaces must have labels and safety data sheets [SDS] for their exposed workers, and train them to handle the chemicals appropriately. The training for employees must also include information on the hazards of the chemicals in their work area and the measures to be used to protect themselves."

The purpose of the safety data sheets (SDS, formerly known as material safety data sheets, or MSDS) required by OSHA is to protect workers by supplying them with the most crucial facts about the hazardous materials at their jobsite, such as the physical properties of the material, proper storage and handling techniques, known health risks and essential emergency procedures.

Thus, manufacturers of amalgam fillings must create these information sheets, and excerpts from just a few of the SDSs for dental amalgam includes compelling evidence about the known dangers of using mercury in fillings:

- SDI; Permite; Lojic +; GS-80, GS-80 Spherical; F400; Ultracaps +; Ultracaps S; SDI Admix; SDI Spherical and New Ultrafine.- Capsules; Australia, Brazil, Ireland, and the USA; 2015:
    - Hazard Identification/California Prop 65 Warning: "This product contains mercury, a chemical known to the State of California to cause birth defects or other reproductive harm."
    - First Aid Measures: "May cause respiratory disorders including inflammation and fluid retention. Inhalation of mercury vapours at high concentration can cause dyspnea, coughing, fever, severe nausea, vomiting, excess salivation, kidney damage with renal shutdown."
    - Toxicological Information/Chronic Health Effects: "Inhalation of mercury vapours, dusts or organic vapours, or skin absorption or mercury over long periods can cause mercurialism. Symptoms include tremors, inflammation of mouth and gums, excessive salivation, stomatitis, blue lines on gums, pain and numbness in extremities, weight loss, mental depression, and nervousness. Exposure may aggravate kidney disorders, chronic respiratory disease and nervous system disorders. May cause damage to blood, kidneys, liver, brain, peripheral nervous system, central nervous system."
- Kerr Corporation; Tytin FC ™; USA; 2014:
    - First Aid Measures/Inhalation: "Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations, salivation, metallic taste, eye irritation, respiratory tract irritation, coughing, pulmonary edema, wheezing and breathing difficulties, headache, fever, nausea or vomiting, diarrhea, abdominal

cramps and pain, muscle weakness / pain, mental confusion or disorientation."

- First Aid Measures/Skin Contact: "Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations."
- First Aid Measures/Ingestion: "Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations."

- Henry Schein; SDS acc. to OSHA HCS/GHS; Stratosphere, Ionosphere, Troposphere; USA; 2016:

  - Risk phrases: "May cause harm to the unborn child. Also very toxic by inhalation. Also toxic: danger of serious damage to health by prolonged exposure through Inhalation."
  - Additional toxicological information: "Avoid exposure of mercury to pregnant person."

CONCLUSION

At this time in history there really is no such thing as "mercury free dentistry" because we have to deal with the legacy of 200 years of amalgam fillings. Part of that legacy is millions of teeth restored, but the other part is a toxic mess that we must struggle with every day in practice.

How far do we need to go to protect ourselves in our patients from toxic exposure when removing their old amalgam fillings? Do we really need hazard style "moon" suits? Should we be developing even tighter isolation techniques for the patients mouth?

We can be sure, though, that our patients understand the need for personal protection from mercury exposure when we remove their old amalgam fillings. They thank us for protecting them, and they respect us for protecting ourselves. Please remember our mercury safe methods are presented as a set of suggestions. Licensed practitioners must use their own best judgment when choosing among treatment options.

POSTFACE TO IAOMT'S SAFE AMALGAM REMOVAL ONLINE LEARNING VIDEO ACTIVITY

Text on screen:

You have finished viewing the video component of this activity. If you are participating in this activity as part of an IAOMT course, you must successfully complete a quiz to obtain credit. Access to the quiz is provided in the "Activity Content" below this video, as well as on the menu to the left. Additionally, the "Materials" tab above this video contains links to references and resources cited in this activity, scientific literature related to the topics presented, and a script for this entire video. Thank you for learning with the IAOMT, as we work together to achieve safer dentistry and a healthier world.