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SUPPLEMENTARY (OPTIONAL) CONTENT FOR UNIT 3

☐ Read the “Best Management Practices (BMP) for Mercury and Mercury Amalgam Removal from Dental Office Waste Water” IAOMT Scientific Review. Click here to go to pages 3-7.

☐ Learn more about the 2016 publication by Kall, Just, and Aschner entitled “What Is the Risk? Dental Amalgam, Mercury Exposure, and Human Health Risks Throughout the Life Span” in *Epigenetics, the Environment, and Children’s Health Across Lifespans* at http://link.springer.com/chapter/10.1007/978-3-319-25325-1_7

☐ Read the “Particulate Inhalation during the Removal of Amalgam Restorations” study by Nimmo, Werley, Martin, and Tansy. Click here to go to pages 8-13.

☐ Read the “Pre-Amalgam Removal: Activated Charcoal Slurry Rinse and Swallow” IAOMT Scientific Review. Click here to go to pages 14-15.

☐ Read the “Alternative Air Sources During Amalgam Removal” IAOMT Scientific Review. Click here to go to pages 16-17.

☐ Read the “Composite Resin Placement — Direct Technique” IAOMT Scientific Review. Click here to go to pages 18-19.

☐ Read the “The Efficacy of the IAOMT Engineering Controls Used During Removal of Mercury Silver Dental Restorations” IAOMT Scientific Review. Click here to go to pages 20-28.
Read the “Mercury Vapor Protection - Under Latex Gloves” IAOMT Scientific Review. Click here to go to page 29.

Read the “Nitrile Gloves – A Barrier to Mercury Vapor” IAOMT Scientific Review. Click here to go to page 30.

Read the “Oral Evacuator Isolate Attachment Clean Up” IAOMT Scientific Review. Click here to go to page 31.

Read the “Oral Methionine for Nitrous Oxide Protection, Increased Wound Healing & Protection from Potential Metal Exposure During Amalgam Removal Procedures” IAOMT Scientific Review. Click here to go to pages 32-35.

Read the “Physical Barriers to Reduce Mercury Exposure During Amalgam Removal” IAOMT Scientific Review. Click here to go to pages 36-40.

Read the “Positive Pressure Fresh Air Source for Amalgam Removal” IAOMT Scientific Review. Click here to go to pages 41-42.

Read the “Reducing Mercury Vapor in the Operatory Common Breathing Space by Ion Precipitation” IAOMT Scientific Review. Click here to go to pages 43-44.

Read the “Rubber Dam for Amalgam Removal” IAOMT Scientific Review. Click here to go to pages 45-47.
Best Management Practices for Mercury and Mercury Amalgam Separation from Dental Office Waste Water

Explanation of IAOMT position: Effective removal of mercury from the waste water of dental offices should be a high priority for all dental practitioners. This review improves and adds additional information pertinent to dental offices and their handling of mercury waste from their offices.

Name of SR: Best Management Practices (BMP) for Mercury and Mercury Amalgam Removal from Dental Office Waste Water

Alternative name(s) of SR: Amalgam Separators and Best Management Practices for Dental Offices

This SR is related to Dentistry.

This SR is a procedure and equipment.

Do you have a vested financial interest in any part of this SR? No

Purpose of the SR: Update previous information/scientific review based on new information regarding mercury solubility from dental amalgam and new technologies that are now available to deal with it.

SR History: An SR on this subject was completed and approved in 1997, reevaluated in 2000, and then again in 2006.

Briefly describe the SR: It has largely been assumed by the scientific community that amalgam and or the mercury in amalgam does not dissolve in water and that by physically removing the particles and particulate of amalgam we would solve the issue of mercury originating from dental offices from entering community waste water systems. As a procedure, removing amalgam particulate is definitely beneficial as a hazardous waste management strategy and this has been proven in a number of studies. This simple strategy however, fails to recognize and or take into account the simple fact that the mercury in amalgam is not bound and or is soluble in water and that this soluble mercury does leach into the dental waste water and then enters the waste water systems that are downstream. New studies designed to look specifically at this issue show that the volume of mercury that escapes the amalgam separator as dissolved mercury can reach numbers that while lower than those from sources without amalgam separators, still greatly exceed EPA and or local municipal standards. As well, this dissolved mercury is in a form that is not readily removable and greatly impacts the ability of publicly owned treatment works (POTW’s), whose responsibility it is to remove the mercury pollution from our waters, from being able to achieve their recommended discharge emissions. The assumption that solid amalgam waste is the only issue for mercury waste water pollution and that achieving a 99% particulate removal solves the problem of mercury discharges into waste water systems, and eventually the environment, is false.
Specifically, by outline if appropriate, describe the SR: Mercury from dental offices contributes significantly to the overall mercury contamination in wastewater. As early as 1990, municipalities in the U.S. and Canada became concerned about increasing levels of mercury entering the environment and in particular that of their wastewater treatment facilities. They soon discovered that a high percentage of the mercury contained in incoming waste water was coming specifically from dental offices. Since that time, a number of studies conducted on this subject now confirm this result and in fact have shown that dental offices waste products are the single largest source of mercury contamination for their publicly-owned treatment works (POTW’s). Technology, in the form of mercury amalgam separators, were designed and created to control dental office releases of mercury and mercury amalgam products that would otherwise enter community waste water treatment facilities (and ultimately therefore into the environment). As a technology, mercury amalgam separators have now been in existence for a number of decades and comprise a large portion of the best management practices (BMP), for mercury in dental waste water that have been mandated in many U.S. States, the country of Canada, and locally in many municipalities that manage the waste water treatment facilities. For the U.S., the EPA is proposing a new rule for all dental offices to reduce the mercury that is entering waste water management facilities, and a new rule for all POTW’s to limit the amount of mercury entering natural waterways from the water exiting these POTW’s. 

The current standard for judging the effectiveness of amalgam separators is an ISO designation - ISO 11143(2008) - and relates only to the percentage of mercury amalgam particulate captured by the separator in a specific one time test. The current standard asks only for a 95% capture rate of the amalgam particulate formula specified in the test, in order to be compliant with, and then receive, certification. This standard however only takes into account the amount of amalgam materials/particulate that is captured. It does not take into account the actual quantity of mercury captured and or the effluent mercury that is discharged from the unit. The standard as well does not account for or address the simple fact that mercury is soluble in water and that there is a significant release of mercury in the dental waste waters that is not being separated by the tested products. The test itself is conducted using neutral pH water and does not take into account that pH and chemicals can and do change the solubility of mercury in water. It has been shown in a number of studies that bleach and other strong chemical cleaners change the solubility of mercury and that under certain conditions, there is a significant increase in the amount of mercury being discharged, i.e. released into these waste waters. The proposed U.S. EPA rule would allow dentists to demonstrate compliance through the use of the best available technology (a combination of amalgam separators and the use of BMP rather than through actual discharge monitoring of the waste water mercury content. This rule is an effort to simplify the compliance with, and enforcement of, these mercury reduction requirements. 

The rule for POTW’s however is completely different. Under the Clean Water Act, EPA has established a true numeric recommended discharge limit of mercury for any water discharges that then flow into natural bodies of water. This means that POTW’s must remove the mercury from their discharge waters to the numeric standard of 0.012 ug of mercury per liter of water. Although this is the EPA recommended standard, many states have adopted their own standards and some have even set a mercury level below this recommended standard. Those states that discharge into the Great Lakes have the extremely low mercury tolerance standard of only 0.0013 ug/l. This recommendation also affects industrial and private discharges into natural waters.

Because of the extremely low emissions standards mandated for POTW’s, many of these local municipalities are examining this issue in an effort to find appropriate solutions. Even with the advent of, and use of, mercury amalgam separators, meeting these mercury effluent standards by many POTW’s is still a major issue/problem. Studies conducted by a private research company on behalf of POTW’s in the state of Ohio show that most mercury amalgam separators allow mercury contamination in the order of 119,000 ng/l of dissolved mercury in as little as 1 day of amalgam being held in solution, and as high as 5,000,000 ng/l mercury contamination. Over longer periods of time, the dissolved mercury rates in all but one mercury amalgam separator were in the 1,000,000 ng/l range. Of all of the available mercury amalgam separators on the market, currently only one separator has been engineered to help remove the soluble mercury - the Mars Bio-Med Processes Inc. Liberty BOSS separator. Within the parameters of the study, this separator was able to maintain a dissolved mercury rate in the tens of thousands ng/l of mercury range versus in the millions of ng/l of mercury range as were all the other ISO 11143(2008) certified separators tested.

As the EPA rule places the greater burden of waste water mercury pollution control on POTW’s, and as the technology for POTW’s to remove soluble mercury is limited, POTW’s and local municipalities are starting to themselves demand that dental offices be accountable for and to the higher standards for mercury amalgam separators. While the future EPA rule will not...
directly burden dental offices with numerical monitoring, POTW’s being mandated to the numeric monitoring standards are being burdened, and in some instances have started legal actions against dental offices that they see as being the originators/creators of excessive mercury pollution. It is very much possible that it may not be sufficient for dental offices to simply comply with the state or EPA standard and or have an ISO certified amalgam separator in order to be free from legal liabilities.(23), (24)

In Canada, the city of Toronto, has enacted a by-law, which has been in force since November 1, 2002, that all dental offices will be required to limit mercury discharges to less than 10,000 ng/l in their dental waste waters and is the strictest limit in Canada.(26) Failure to comply with this by-law could result in fines of $10,000 to $100,000 per day.(26) Toronto City Council has already approved six new enforcement officers to monitor compliance. Private citizens and environmental groups can also launch private prosecutions against dentists and property owners who fail to comply with the by-law.(25), (26), (27) Other Canadian cities that require dentists to install amalgam separators are: Calgary, Alberta; Montreal, Quebec; Kingston, Ontario, and Victoria, B.C.(26), (27)

In the U.S., the city of Elyria, Ohio has a dental waste water by-law with an upper limit of 4,000 ng/l mercury, and the city of Denver, Colorado has set an upper limit of 7,000 ng/l mercury, for waters entering the waste water management facility. So while an ISO 11143(2008) certified mercury amalgam separator is an important piece of equipment in the overall dental hazardous waste management strategy, it does guarantee compliance in regards to many of these by-laws. There is currently only one amalgam separator on the market that is able to achieve the reduction of mercury within dental waste waters discharges to the numeric standards as they exist in these communities.(10)

As well, a number of studies conducted on behalf of POTW’s, suggest that the maintenance of the mercury amalgam separator is a largely overlooked and yet crucial element to achieving the desired 95 to 99% reduction of amalgam particulate removal. In actual office settings, almost all of the ISO certified separators failed to achieve the desired 95 to 99% collection requirement. Differences in flow rates, volume of water, quantity and size of particulate, duration of contact with water were all factors that influenced the percentage of particulate that was actually separated out/captured.(10) Amalgam separator collection concerns, as it relates to proper maintenance, or the lack thereof, is in relation to amalgam particulate discharges only and does not take into account the failure of most separators to remove the dissolved/soluble mercury contained within dental waste waters.

Currently, 13 states (Connecticut, Louisiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, and Washington) have implemented mandatory programs to reduce dental mercury discharges. Additionally, at least 19 localities similarly have mandatory dental reduction pretreatment programs. To date, most of these mandatory programs only require the use of amalgam separators and BMPs as the focus of their mercury reduction strategies.(16), (17)

With the advent of the coming EPA rule and its implications for both dental offices and POTW’s, it is crucial for dental offices to: 1). understand the very real differences, i.e. the strengths and or limitations, of the various mercury amalgam separators currently available, 2). effective maintenance protocols for these separators and the various factors that affect the effectiveness of the separator, and 3). the importance of truly achieving best management practices as mandated by law for mercury amalgam waste in dental waste water, in order to; 4). protect the environment, and just how much mercury is being released down line to waste water management facilities.(18)

The Environmental Committee of the IAOMT has gone on record as recommending all dentists install an ISO certified mercury amalgam separator.

Manufacturer(s), distributor: MARS Bio-Med Processes Inc.

Scientific Literature: References are included below which support the various statements made in the scientific review.

Legal Aspects of this SR: Mercury as a global pollutant is a huge concern/issue in today’s environmentally conscious society. The United States EPA, Environment Canada and at the municipal level, POTW’s, are all being forced to examine all aspects of mercury pollution and to look at every means possible at reducing mercury pollution sources. Dentistry has now been established as a significant contributing source of mercury pollution and it is important not to just reduce the amount of mercury pollution, but to actually work towards the total elimination of mercury pollution sources.

Best Management Practices, as a disposal option for Hazardous Dental Waste Disposal, is the pollution prevention principle/principles that goes beyond the minimum requirements set by law. BMPs should always be the goals against which
current practices are measured as it is a reflection of current knowledge and commercially available technology and methods, as it asks that we practice with the highest standards of care, and not just the minimum as may be set by law.

The laws concerning dental hazardous waste water emissions are varied and exist with unique requirements on the nation, state, and or municipal level. It is incumbent on the individual practitioner to know the laws and by-laws of governance in their own country, state, and municipality and on the unique qualities and maintenance requirements that will achieve compliance.

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3). [http://www.epa.gov/mercury/dentalamalgam.html#contamination](http://www.epa.gov/mercury/dentalamalgam.html#contamination) How Much Mercury Contamination in Wastewater Comes From Dental Sources?


11). Marek M, Dissolution of Mercury from Dental Amalgam at Different pH Values, J Dental Research, June 1997 vol.76 no. 6 1308-1315.


Particulate inhalation during the removal of amalgam restorations

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An aerosol that contains amalgam particles is created when a high-speed hand-piece is used to remove an existing amalgam restoration. Those particles smaller than 10 μm are considered to be fully respirable. This means that a significant percentage of the particles have the potential to travel to the terminal alveoli, where they may become lodged. Long-term exposure to fully respirable particles may compromise a person's respiratory function. Amalgam restorations were placed in the typodont tooth of a mannequin designed to simulate the head and the respiratory tract of a patient. The amalgam restorations were removed under three experimental conditions: dry cut (control), wet cut (water spray) with high-velocity evacuation, and wet cut with high-velocity evacuation and a rubber dam. Particulate exposure was evaluated in the simulated respiratory tracts of the patient and the dentist that were equipped with ambient particle sizing samplers. Use of water spray and high-velocity evacuation significantly reduced patient exposure to particles. The use of a rubber dam, together with water spray and high-velocity evacuation, was responsible for a further significant reduction of exposure to particles when compared with water spray and high-velocity evacuation alone. The dentist, however, was exposed to moderate levels of fully respirable particles for all conditions tested. It is therefore recommended that all dental personnel wear face masks while removing existing amalgam restorations. (J PROSTHET DENT 1990;63:228-33.)

The dental community has become increasingly cognizant of the occupational hazards associated with the practice of dentistry. Dental personnel are exposed to multiple hazards, including toxic materials, infectious diseases, and noise. Inhalation of mercury vapor has long been recognized as an occupational hazard. Inhalation in general practice frequently removes amalgam restorations and places new restorations. This contributes to the level of mercury vapor to which dental personnel are exposed.

The threshold limit value (TLV) for continuous occupational exposure to mercury vapor is 0.05 mg/m³. Several researchers have investigated the ambient atmospheric levels of mercury vapor produced during amalgam removal. Buchwald recorded mercury vapor concentration levels in 23 dental offices. He determined that amalgam removal produced an average mercury vapor concentration level of 0.4 mg/m³ for a 2-minute period. Cooley and Barkmeier found a range of 0.5 to 1 mg/m³ during amalgam removal. They reported on finding a significant reduction in the level of mercury vapor when central vacuum evacuation was used during amalgam removal. They also found that evacuation was more important than the use of water spray to reduce the level of mercury vapor.

Koski et al. compared the mercury vapor production level for four procedures: trituration of preproportioned amalgam capsules, manual proportioning of amalgam, amalgam condensation, and amalgam removal. They determined that amalgam removal was the most hazardous procedure, producing mercury vapor levels in excess of 0.50 mg/m³. Reinhardt et al. reported in an in vitro study that the use of water spray during removal of amalgam restorations significantly reduced the level of mercury vapor (0.65 mg/m³ down to 0.11 mg/m³). Richards and Warren measured the level of mercury vapor in the dentist's breathing zone during amalgam removal and also evaluated the amount of mercury vapor exhaled by the dentist after the procedure. They concluded that, although the use of water spray resulted in a decrease of mercury levels, the combination of high-volume aspiration and water coolant was more effective. In each of these studies a mercury vapor level well in excess of the TLV was observed during amalgam removal that took place without the use of water spray and high-velocity evacuation.
In addition to the mercury vapor hazard, a hazard of particulate inhalation is also associated with removal of amalgam restorations. When a high-speed handpiece is used to remove an existing restoration, the amalgam is aerosolized into minute particles. These particles are circulated in the air and may be inhaled by the patient and all dental personnel that are present. Inhaled particles larger than 10 μm are generally filtered out in the nasal passages by becoming lodged onto the nasal mucosa and are removed from the upper respiratory tract by movement of the olfactory cilia into the pharynx, where they are usually swallowed. Particles of less than 10 μm are considered to be fully respirable: when inhaled, a significant number will enter the terminal bronchioles and alveoli. Inhalation of particles of 1 μm is estimated at 10%.

Several problems arise when small particles become lodged in the terminal alveoli. The aerosol generated during removal of amalgams and the underlying lesions will contain varying amounts of microorganisms that, if lodged in the alveoli, may lead to infection. The time required for phagocytic cells to clear the alveoli is long because of the lack of ciliary transport. Clearance half-times range from several weeks to months. In addition to respiratory diseases, aerosolized particulates may represent a significant source of mercury that may have a half-life of only a few days but may last up to a year.

Cutright et al. demonstrated systemic uptake after the inhalation of particulate mercury in an animal model. They found that the mercury levels of the blood and the organs were markedly elevated for more than 72 hours after exposure to aerosolized amalgam particles. Musajo et al. reported similar findings in a more recent study of animals.

Recently, the issue of patients being exposed to mercury vapor has drawn significant public interest. Reinhardt et al. have evaluated the level of mercury vapor to which a patient is exposed during the removal of amalgam restorations and have recommended the use of water coolant, high-velocity evacuation, and a rubber dam. In spite of the foregoing, researchers have not fully investigated how water coolant, high-velocity evacuation, and the rubber dam affect patient particulate inhalation during the removal of an amalgam restoration.

The purpose of this in vitro study was to estimate the amount of particulate inhalation by the patient and by the dentist during the removal of existing amalgam restorations under varying conditions.

METHODS AND MATERIAL

The simulation of a patient's head and respiratory tract consisted of a mannequin head (model no. XPH-2, Columbia Dentoform, Long Island City, N.Y.) and a typodont (model no. M 860, Columbia Dentoform) mounted on a mannequin rod (model no. M-1R-7, Columbia Dentoform) (Fig. 1). The head of the mannequin was connected to an Andersen Cascade Impactor particle sizer (model Mark II, Andersen Samplers, Inc., Atlanta, Ga.). This particle sizer was chosen because it was designed and experimentally verified to represent a reasonable simulation of the various levels of the human respiratory tract. In essence, the particle sizer is a filtration system that consists of nine stages, with each stage representing a specific level of the respiratory tract. Each stage is loaded with a preweighed piece of glass fiber filter paper. A vacuum pump draws the particles through the particle sizer and traps them according to size. The particle sizer was attached to the mannequin head to simulate the respiratory tract of a patient. Plastic wrapping material was used to seal the connection between the mannequin head and the particle sizer.

The simulation of the respiratory tract of a dentist was made by use of a second particle sizer (without an attached mannequin head) positioned so that the intake orifice approximated the breathing zone of the dentist (40 cm from the cutting surface).

Maxillary left second premolar typodont teeth were prepared to receive an average-size three-surface (MOD) amalgam restoration. The dimensions of each preparation

Fig. 1. Experimental setup. One particle sizer is positioned to monitor dentist's inhalation zone. A second particle sizer is positioned under mannequin head to directly sample patient inhalation zone.
follow: isthmus (1.5 mm wide, 1.5 mm deep), proximal box (2 mm wide, 1.5 mm deep). Each tooth was restored with Tytin (Kerr, Romulus, Mich.) amalgam. Each restoration was stored for 24 to 36 hours in water that was maintained at room temperature.

With a high-speed handpiece that had a No. 556 bur, each amalgam restoration was removed in approximately 2 minutes. The patient and dentist particle sizers simultaneously sampled the aerosol produced during the time of amalgam removal.

Nine restorations were removed under each of the following conditions:
1. Dry cut—no water spray, no high-velocity evacuation (control)
2. Wet cut—water spray from handpiece, high-velocity evacuation
3. Wet cut with rubber dam—water spray from handpiece, high-velocity evacuation, and rubber dam

After the removal of each amalgam restoration, the particle sizers were shut off and carefully disassembled. The filter paper was weighed to determine the mass of the inhaled particles. The units were then replenished with new preweighed filter paper for each successive run.

The inhaled particles were evaluated according to two parameters—mass and size. A summary of the data is presented in Tables I and II. Particle sizes represent mass median diameters with geometric standard deviations. The data were subjected to two-tailed Student’s t-test analyses at the p < 0.05 level of significance.

**RESULTS**

Under the control condition (dry cut), the patient model inhaled large amounts (17.8 ± 13 mg) of relatively large particles (7.92 ± 1.81 μm). Under the wet cut condition (water spray, high-velocity evacuation) there was a significant reduction in particulate inhalation, in amount (4 ± 2.6 mg) and in size (1.44 ± .60 μm) (Figs. 2 and 3). In spite of these reductions, the patient inhaled moderate
PARTICULATE INHALATION

Fig. 3. Particulate inhalation during amalgam removal: particle size (μm). *Amount collected for patient in wet cut/RD condition was too small to allow particle size analysis.

amounts of fully respirable particles under the wet cut condition. A scanning electron micrograph reveals the shape of a fully respirable amalgam particle (Fig. 4).

The application of a rubber dam, in addition to water spray and high-velocity evacuation, produced a further significant reduction of particulate inhalation by the patient in this in vitro model. The amount collected was so small that particle size evaluation was not possible.

In the simulation of a dentist, moderate amounts (2.3 to 4.4 mg) of fully respirable particles were inhaled regardless of testing conditions. The size of the particles inhaled by the dentist remained relatively constant, with the means ranging between 1.35 and 2.02 μm. No significant differences were found in the amounts collected or sizes of particles inhaled by the dentist for any of the conditions tested.

DISCUSSION

A safe office environment is an important consideration for all dental personnel and patients. Previous studies have demonstrated that, to ensure a safe environment, amalgam should be handled and disposed of properly, and exposure to it must be limited. In dental offices dental personnel and patients also risk inhaling particles during the removal of amalgam restorations. This study characterizes the nature of the particles to which patient and dentist might be exposed. We collected and measured particle size and mass of particles that might penetrate the respiratory tract.

The human respiratory tract can be modeled as an aerodynamic classifying system for air-borne particles. The Andersen Cascade impactors used in this study serve as substitutes for the respiratory tract as a particle collector. As such, the impactors we used in this study reproduced (to a reasonable degree) the dust-collecting characteristics of the human respiratory system. The inhaled particles retained in the respiratory system and the site of deposition vary with size, shape, density, and all of the physical properties of the particles that contribute to aerodynamic dimensions. The Andersen sampling devices classify the particles collected according to the aerodynamic dimensions, which is a true measure of lung penetrability.

This study evaluated particulate inhalation during amalgam removal in the breathing zones of the patient and the dentist. Each zone is distinctly different. In general, patients are more likely to be exposed to large particles be-

Fig. 4. Scanning electron micrograph view of individual airborne amalgam particle that was collected on glass fiber filter paper. Calibration bar represents 1 μm. Amalgam particle measures 4 by 7 μm. When inhaled, most of particles this size and smaller avoid clearing mechanisms of conducting airways and reach terminal bronchioles and alveoli. They are thus classified as fully respirable (original magnification x6000).
cause of their proximity to the operative site and because of gravitational effects. In contrast, the dentist, who is further removed from the operative site, would be exposed to smaller particles.

The use of water spray and of high-velocity evacuation during amalgam removal significantly reduced the total mass of particles inhaled by the patient. The water spray may help to coalesce some particles while the suction source draws some particles away from the operative site. The use of water spray, high-velocity evacuation, and a rubber dam almost completely eliminated particulate inhalation by the patient. This additional reduction of particulate inhalation by the patient may be attributed to the rubber dam’s increased physical containment of particles or to the electrostatic attraction of very small particles to the surface of the rubber dam. These findings along with other reports support the routine use of a rubber dam together with water spray and high-velocity evacuation during amalgam removal. Furthermore, patients with compromised respiratory function should be afforded the additional protection that the rubber dam provides.

The simulation of the dentist was exposed to moderate amounts of fully respirable particles for all conditions tested. This is in concurrence with the findings of Buchwald, who found that suction and water coolant had little effect on the dentist’s exposure to respirable particles. The data on particle size imply that half of the inhaled particles could be expected to become lodged on the level of the terminal bronchi and lower in the respiratory tract. Amalgam removal is more of a hazard to dental personnel, because they are exposed to particles over a long period of time. Patient exposure, on the other hand, is normally episodic in nature. Although the long-term effects of amalgam particulate exposure have not been identified at this time, it should not be assumed that there is no hazard. Exposure to other respirable particles in the dental office has proved harmful.

CLINICAL IMPLICATIONS

The findings presented in this article should strongly motivate all dental personnel to use face masks when doing routine removal of amalgam restorations. Previous findings have shown that the face mask should act to filter out most of the fully respirable particles. Further research needs to address the efficacy of face masks in filtering fully respirable particles produced during amalgam removal.

CONCLUSIONS

1. The patient is best protected against particulate inhalation by the use of a water spray and high-velocity evacuation, together with a rubber dam, during amalgam removal.

2. The dentist is exposed to moderate amounts of fully respirable particles during amalgam removal. It is recommended that a face mask be used by all dental personnel present during amalgam removal.

We thank Mr. Harold Perrong, research technician, for his valuable assistance in this research.

REFERENCES


The effect of immersion disinfection of elastomeric impressions on the surface detail reproduction of improved gypsum casts

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This investigation examined improved gypsum casts for surface roughness and line-detail reproduction after the immersion disinfection of elastomeric impression materials in an acid glutaraldehyde, an alkaline glutaraldehyde, and a phenol. Impressions were made of a surface roughness standard (Ra = 3.08 µm) that was custom made to include engraved grooves following American Dental Association specification No. 19. Mean surface roughness (Rz) values for all casts of all combinations of disinfectant treatments, impression materials, and improved gypsum stones were obtained with a surface analyzer. Untreated impressions served as controls. Data examined by an analysis of variance indicated that the addition silicone and polyether impression materials provided a surface roughness similar to the precision displacement specimen standard. The acid glutaraldehyde disinfectant demonstrated enhanced line-detail reproduction compared with the standard. Addition silicone and polyether impression materials combined with the acid glutaraldehyde provided the model system closest to the mean surface roughness of the reference standard. These combinations revealed differences in the surface roughness reproduction among the represented improved dental stones. (J Prosthet Dent 1990;63:233-41.)

A working cast-and-die system of improved dental stone used with cast dental restorations must provide dimensional accuracy, strength, and resistance to abrasion, and must reproduce surface detail. With the present laboratory practice of placing a die spacer on the replicated, prepared tooth surfaces of stone dies to allow space for the luting agent, the necessity of accurate surface reproduction may not appear to be as important.1,2 Accurate detail reproduction of the surface adjacent to the finish line, which is not covered with a die spacer, is requisite to a serviceable, well-adapted cast restoration. The improved dental stone cast cannot give more information than that that is accurately provided by the impression material used.3

The prevalence of the human immunodeficiency virus (HIV) and other infectious diseases in blood and other body fluids has influenced the necessity for personal protection and the prevention of disease transmission.4,5 All surfaces that have been splashed or touched by human body fluids must be disinfected with a hospital-grade disinfectant that has been registered with the Environmental Protection Agency (EPA).6,7 Because dental impressions contact saliva and blood, immersion disinfection is used as a method of preventing microorganism transmission from the patient to personnel who handle the impression and
Pre-Amalgam Removal:
Activated Charcoal Slurry Rinse and Swallow

Explanation of IAOMT position: A logical, much needed additional defense against the acute absorption of the mercury released during mercury amalgam removal.

Name of Scientific Review: Pre-amalgam Removal – Activated Charcoal Slurry Rinse and Swallow

Alternative name(s) of Scientific Review: Charcoal Powder Rinse

This Scientific Review is related to: Dentistry

This Scientific Review is a: Procedure

Do you have a vested financial interest in this Scientific Review? No

Purpose of the Scientific Review: To prevent patients from absorbing non-suctioned off and potentially toxic mercury from mercury amalgam particles when drilling out.

Scientific Review History: Ingested activated charcoal capsules have been suggested to prevent absorption of non-suctioned mercury from amalgam particles from the digestive tract. This procedure enhances the prevention of mercury absorption through all oral soft tissues as well. It is inexpensive, simple, fast and tasteless.

Briefly describe the Scientific Review: Before mercury amalgams are drilled out have the patient rinse and swallow a slurry of activated charcoal powder and water.

A specifically, by outline if appropriate, describe the Scientific Review: Activated charcoal has long been known and used to absorb toxins, drugs and poisons from the human body. It can absorb up to 10,000 times its own weight in toxins. Powder is the most effective form.

Procedure:
1. In a small disposable cup, dissolve 1 teaspoon of activated charcoal powder in 1 ounce of water.
2. Before removing amalgam, before anesthetic, have the patient briefly rinse then swallow the slurry.
3. The oral mucosa and tongue will be coated with the black powder to prevent the absorption of non suctioned mercury and amalgam particles and the digestive tract will benefit from better protection as well.
4. As soon as all amalgam has been drilled out, thoroughly rinse the visible black powder from all accessible mucosa with water spray and suction for at least 45 seconds.

Manufacturer(s), Distributor(s), or Publisher:
- Most Health Food Stores
- In Canada: Ray’s Foods, PO Box 607 Greenwood, BC, V0H 1J0 : 1-888-707-3663
  Email: ray@abundanthealth.info
- In USA: http://www.BuyActivatedCharcoal.com Crawford, NE 69339 1-308-665-1565

Scientific Literature: Contact Dr Pierre Larose
- Cooney, David Ph.D. ACTIVATED CHARCOAL: Antidote, Remedy and Health Aid, Teach Services Inc. Brushton NY, 1999
- American Academy of Clinical Toxicology; European Association of Poison Centres and Clinical Toxicologists,
Legal Aspects of this Scientific Review: ******ONLY CONTRAINDICATION:******

- Activated charcoal will absorb all drugs taken two hours prior or two hours after ingestion.
- Ensure patient has not taken or will not take any important medication (birth control pills, antibiotics, chronic disease medication, etc) in the two hours before or two hours after ingesting the charcoal.
- If the patient has taken medication in the critical time period, have him/her rinse and spit out the charcoal back in the cup to protect the oral mucosa only at this time but not swallow the mixture.
- Prescribe charcoal to be ingested later if deemed appropriate.
- Activated charcoal does not absorb vitamin or mineral supplements.

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<td>IAOMT Chapter: North American</td>
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# Alternative Air Sources During Amalgam Removal

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<tr>
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**Explanation of IAOMT position:** Not enough science to support conclusions

**Name of Scientific Review:** Review of Alternative Air Sources During Amalgam Removal

**Alternative name(s) of Scientific Review:** Oxygen vs. Nitrous Oxide Vs. Fresh Air as Preferred Alternative Air Source During Amalgam Removal

**This Scientific Review is related to:** Dentistry

**This Scientific Review is a Procedure**

**Purpose of the Scientific Review:** To help decision making in sources of air during amalgam removal

**Scientific Review History:**

It is well recognized that an alternative source of air (oxygen, fresh or room air, nitrous oxide) is preferable to no nasal protection at all while removing dental amalgam fillings, see IAOMT Scientific Review “Reducing Mercury Vapor Exposure to the Patient During Amalgam Removal”. The concept is that by blocking direct inhalation of mercury vapors during removal, the patient exposure will be greatly diminished.

**A brief description of the Scientific Review:**

**A specific description of this Scientific Review:**

When removing amalgam fillings, the IAOMT recommends an alternative source of air be provided for the patient.

**Discussion:**

1) **Alternate source of fresh air:** Fresh, filtered, outside air may be the safest choice. A fan that filters outside air and is carried with slight positive pressure via a nasal cannula to the patient will allow the patient an alternative air choice to minimize exposure to mercury vapors. Filtered room air is second choice for it may contain more pollutants like mercury vapor, spores, etc.

2) **Alternate source nitrous oxide:** It is documented that there are health concerns with the use of nitrous oxide, e.g. brain toxicity, detoxification issues, pregnancy concern, etc. (See IAOMT SOC’s “Optional Mercury Removal in Pregnant & Lactating Women” and Oral Methionine for nitrous oxide protection, increased wound healing & protection from potential metal exposure during amalgam removal procedures.” If pure oxygen may be dangerous, it is possible that nitrous oxide allows a greater degree of safety due to its lower concentration of oxygen and presence of nitrogen.

3) **Alternate source oxygen:** Dietrich Klinghardt, MD, recently cast questions as to the wisdom of this policy with information that oxygen will “open” the blood brain barrier so as to increase the patient’s exposure to mercury vapors during mercury amalgam removal. Upon further inquiry, this information was from Dr. Max Daunderer of Germany.

**Conclusion:** This issue needs further research and discussion

**Manufacturer(s):** Any maker of delivery units for oxygen, nitrous oxide, or monitored/filtered fans.

**Scientific Literature:** At this time, it is not clearly documented in the scientific literature that any one source of air is safer for the patient

**Legal Aspects of this Scientific Review:** N/A now

**Applicant Name:** Mitchell Marder, DDS, AIAOMT

**Office Phone:** 206-367-6453

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**Received:** 3/17/99
**Scientific Review:** 4/19/99
**IAOMT Board Review:** 4/29/99
**Reevaluation:** 9/01/00

Unit 3 OPTIONAL IAOMT Accreditation Materials as of December 18, 2017; Page 16
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Composite Resin Placement — Direct Technique

Explanation of IAOMT position: It is one thing to remove mercury amalgam fillings safely but we must also be experts at placing direct composites!

Name of Scientific Review: Composite Resin Placement — Direct Technique

Alternative name(s) of Scientific Review:

This Scientific Review is related to Dentistry

This Scientific Review is a Procedure

Purpose of the Scientific Review: To set clinical standards of excellence for composite resin placement.

Scientific Review History: Compilation of many classes and clinical experience.

A brief description of the Scientific Review: Revision update for placement of direct composite resins.

A specific description of this Scientific Review:
1. Prep the cavity to remove all decay and previous filling materials. A fresh, clean tooth surface is essential to obtain maximum bonding of the dentine and enamel.
2. Use caries indicating dye (various companies) to check for decay
3. Isolate, wash tooth with 2% Chlorohexidine soap for 15-20 seconds
4. When appropriate, place matrix band (different types and manufactures), wedge if necessary to seal the gingival box area
5. Etch (total) with 37% phosphoric acid for 15 seconds. Etch each tooth separately if you cannot maintain the etch on the tooth for 15 seconds (no less time; no more time)
6. Rinse the prep area thoroughly for 20-30 sec. using generous water spray and suction
7. Wash the prep area with Chlorohexidine soap for 15-20 sec & suction off excess liquid.
8. Use EDTA agent either Tublicid Red (fluoridated) or Tublicid Blue for 15 seconds.
9. Dry the preparation. Either by blotting with a cotton pledgett or air, but do not dehydrate the tooth!
10. Use bonding agent of your choice, either bond-prime 2 step or 1 step or self etching bond and prime. If you use a self-etching bond and prime omit #5 and do steps # 6, 7, 8, 9 before placing self-etching prime and bond.
11. After placement of bonding agents (operator’s preference) start placement of composite (choose a composite with minimal shrinkage; nano technology; ceromer technology)
12. When placing composites, an incremental placement is the preferential method with light activation for each increment and light activate the top layer of the restoration
13. When finishing your placement, try to contour the restoration as much as possible
14. Remove the matrix and wedges; cure buccally and the lingually at each contact restored for 10 seconds
15. Finish the restoration with appropriate instrumentation, contouring the occlusal surface and Buccal-lingual line angles to restore normal tooth contour
16. Final restorative procedures would involve checking occlusion and polishing the restoration with points, disks, etc., along with a 10 second cure of the occlusal surface.
17. Optional step: isolate, etch for 10 sec, rinse for 30 sec, and flow on a thin layer of glaze material to seal any imperfections, fractures, cracks, air bubbles, etc. and then do a final cure of the entire restoration.

Manufacturer(s): N/A

Scientific Literature: Related to clinical experience coupled generally accepted Scientific Review of the Profession regarding
Legal Aspects of this Scientific Review: Standard of Care for quality of placement of direct resins according to generally accepted Scientific Review of the dental profession.

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The Efficacy of the IAOMT Engineering Controls Used During Removal of Mercury Silver Dental Restorations

Explanation of IAOMT position: "This review is the first to quantify the mercury released during dental mercury amalgam removal. The data mandates that more serious consideration be given by all dentists, worldwide, to protecting themselves, their staff and patients from exposure and consequences of mercury vapor and particulate during mercury amalgam removal procedures. While the data is in its infancy the impact and ramifications of this data warrants immediate consideration by the academy. This review in its current form is not intended to shape the academy’s position or require immediate action but is intended to stimulate discussion and raise awareness of our current systems during Hg removal. As such this review has not been given approval by the Scientific Review committee. We have every expectation that it will be in the future. For now we prefer that the data speak for itself and a healthy discussion to begin that will guide and shape the conclusions of this study.

The explanation and ramifications of mercury exposure can be found in the "International Academy of Oral Medicine and Toxicology (IAOMT) Position Statement against Dental Mercury Amalgam Fillings for Medical and Dental Practitioners and Patients" found at www.IAOMT.org. Expect constant updates and enhancements to this SR in the future."

Name of Scientific Review: The Efficacy of IAOMT Controls Used During Removal of Mercury Silver Dental Restorations

Alternative name(s) of Scientific Review: Efficacy of Protection During Mercury Amalgam Removal

This Scientific Review is related to Dentistry & Medicine

This Scientific Review is both a Procedure & Equipment

Do you have a vested financial interest in any part of this SR? No

Purpose of the Scientific Review: To determine the efficacy of engineering controls in preventing the exposure to
mercury vapor and mercury particulate during the removal of mercury-silver fillings.

**Scientific Review History:**
5. Ziff, update Sukel (2005) Reducing Mercury Vapor Exposures for Doctor and Staff During Amalgam Removal

**A brief description of the Scientific Review:** We designed a study to measure Hg vapor and particulate levels using IAOMT recommended controls while removing mercury silver fillings and using procedures recommended by the American Dental Association.

Our data indicates that with all engineering controls in place (Tact-Air, Clean-up, IQ Air Cleaning Device, Water Spray, and Suction) the dentist, patient, and assistant are exposed to mercury at levels that exceed the level allowed by the Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), and the Agency for Toxic Substances and Disease Registry (ATSDR).

The average levels are generally lower when engineering controls are in place. However even when all engineering controls in place practitioners, assistants and patients are exposed to high levels of mercury particulate.

Engineering controls are required to keep levels as low as possible, but do not provide enough protection to eliminate exposure by inhalation to mercury vapor and particulate nor prevent direct contact with mercury particulate to exposed skin surfaces or clothing worn by the dentists, team members, and the patient. Our test showed that vapor and particulate cannot be separated. Vapor generated during the removal of mercury fillings contains particulate and the presence of particulate on any surface will emit vapor.

Scrubs, uniforms, and cloth masks do not provide any form of protection to the dentists or team members and may increase exposure as mercury particulates accumulate with multiple procedures. Our data show that while our current engineering controls reduce exposure by as much as 2000 times there is still a significant exposure. We suggest that additional measures should be employed to further reduce mercury exposure, including full-face respirator mask designed to filter mercury vapor and mercury particulate.
A specific description of this Scientific Review:
Six sessions removing 8 two surface mercury silver fillings from a simulated patient. Hg particulate, Hg vapor and particulate, and Hg vapor were measured for each session. The first session all controls were in place, a control was removed for each session until no controls were used. The same methods were used to collect data for each session.

Session One - Clean-up, Water, IQ Air, Tact Air,
Session Two – Clean-up, Water, IQ Air,
Session Three – Regular Intra-oral Suction, Water, IQ Air
Session Four - Regular Intra-oral Suction, Water
Session Five – Regular Intra-oral Suction
Session Six - No controls (cutting dry)

During each session three different sets of mercury concentrations were recorded and are labeled as follows:

Peak Mercury Vapor Levels (ug/m³). – Measured at the Dentists, and Assistants shoulder using a Mass Spectrophotometer 3000
Average Mercury Vapor Levels (ug/m³). – Measured at the Dentists, and Assistants shoulder using a Mass Spectrophotometer 3000
Mercury Particulate and Vapor (ug/m³). – Measured at the Dentist and Assistants shoulder using Air sampling pumps and tubes with cellulose ester filters
Mercury Particulate (ug/100 cm²) – Measured by swab of a 100 cm² section from the same sites on the assistant and patient for each session.

DATA:
We expected to see all values increase as engineering controls were removed. Our goal was to determine the effectiveness of each control so that the safest protocol could be recommended for dental teams as they remove mercury silver fillings.

OSHA has not established occupational levels for mercury particulate except for a general warning that it should not be allowed to accumulate on surfaces. There is no safe level for the chronic exposure that is received by the dental team. A level for mercury vapor of 0.2 ug/m³ was determined to be the lowest concentrations known to cause any level of harm to humans (the lowest toxic concentration level for humans [TCLo]) by a joint workgroup of the Environmental Protection Agency (EPA) and the Agency for Toxic Substances and Disease Registry (ATSDR):

Chemical-Specific Health Consultation
for Joint EPA/ATSDR National Mercury Cleanup Policy Workgroup
Action Levels For Elemental Mercury Spills
March 22, 2012

“Both ATSDR and EPA have developed health guidance values (HGVs) for inhaled mercury vapors, based on a 1983 study of workplace exposures [Fawer 1983]. The workers in the study were exposed in their workplace to mercury vapors. The workers in the Fawer cohort came from three different types of workplaces: fluorescent tube manufacture; chloralkali plants; and acetaldehyde production. The authors reported a Lowest Observed Adverse Effect Level (LOAEL) of 26 ug/m³ of exposure averaged over a period of 15 years [Fawer 1983]. As discussed
below, the effect noted in the study was a slight tremor in the hands. ATSDR has defined a Minimal Risk Level (MRL) for chronic exposures (more than 365 days) to mercury of 0.2 ug/m³. In developing the MRL, the workplace average from Fawer was adjusted from a 40-hour to a 168-hour exposure per week (i.e., 24 hours/day, 7 days/week), and then divided by an uncertainty factor of 30 (3 for use of a minimal LOAEL and 10 for human variability) to account for the LOAEL and individual sensitivities.

The mercury vapor peak levels in the next four graphs obtained from the Mercury 3000 cold mass spectrophotometer show a linear increase in mercury vapor as engineering controls were removed. With all controls in place the values were lower but above the 0.2 ug/m³ MRL for Hg vapor.

**Peak Mercury Vapor Levels**

![Graphs showing peak mercury vapor levels for assistant and dentist with and without engineering controls.]

**Average Mercury Vapor Levels**

The average levels were obtained in the same fashion as the peak mercury levels but were averaged over the course of the session rather than the peak value obtained during the session. A linear increase in exposure occurred as each engineering control was removed. The values with all controls were greater than the 0.2 ug MRL.
Mercury Particulate and Vapor

Mercury vapor combined with mercury particulate was collected using air sampling pumps and tubes (Carulite Lot 7403 SKC, Cat. No. 226-17-1A) and cassettes with un-weighted, mixed, cellulose ester filters. The samples were analyzed by Galson Laboratories Inc. using NIOSH method 6009.

The sampling pumps, which collected particulate and vapor, always detected larger amounts of mercury than just measuring the vapor alone with the Mercury 3000. This was the first indication in the study data that particulate could be contributing to a significant overlooked exposure source.
Mercury Particulate

Surface sampling for particulate was conducted with 2 inch by 2 inch sterile gauze that was moistened with deionized water prior to wiping a surface of interest. Wearing new disposable gloves for each wipe sample, the industrial hygienist moistened the gauze and wiped a 100 cm² area with the gauze. Several sites were sampled for the assistant and the patient. The samples with the greatest particulate values are shown. The samples were analyzed by Galson Laboratories, Inc.

The surface sampling for particulate showed a consistent increase in mercury sampling on the patient and assistant as engineering controls were removed. The assistant’s knee closest to the operative site maintained the highest levels of particulate. A value of 330ug was found on the patient’s chest with all controls in place, which is 10 inches (25 cm) from the operative site. The peak values steadily increased as engineering controls were removed. The patient’s highest levels of particulate were found on the chest with particulate traveling to the knee after the tact-air and clean-up were removed. Particulate measurements steadily increased in value and particulate was detected further from the operative field as engineering controls were removed.

Total Mercury Vapor

The total mercury vapor per session detected by the Mercury Instruments 3000 cold mass spectrophotometer
is shown in the following graphs and in Table six. The Mercury 3000 cold mass spectrophotometer monitored the vapor in real time during the removal, including the five minutes we waited each session before collecting surface samples for particulate. The total mercury vapor for each session was available from the data collected by the Mercury 3000. The total mercury vapor for each session increased in a linear progression as each control was removed. Time was not a factor as shorter operative segments still showed an increase in quantity of mercury vapor. It is important to evaluate the total mercury vapor as the dentist and assistant are exposed to the entire mercury vapor that is created by a procedure and not just to the averages and peaks.

![Graphs showing Mercury 3000 readings](image)

**Discussion**

No limits for mercury particulate amounts have been set, but OSHA compliance directive cpl-02-02-006 states “all exposed surfaces should be maintained free of accumulation of mercury, which, if dispersed would result in airborne concentrations in excess of the permissible exposure limit or in a visible dust cloud”. NIOSH assigns a "Skin" notation, which indicates that the cutaneous route of exposure, including mucous membranes and eyes, contributes to overall exposure [NIOSH 1992] [9]. As the dentist and team members are exposed multiple times during a normal work day, this discussion will assume for any level of exposure above zero for mercury vapor or mercury particulate, maximum personnel protection procedures should be used for the patient, dentists, and team members.

In a 10 square foot room, 5 ug of vaporized mercury would elevate the air concentration of mercury to the Agency of Toxic Substances and Disease Registry Minimal Risk Level. The data from sessions one (All Controls) and two (Tact-Air Removed) shows the dentist assistant and patient are exposed to mercury vapor and mercury particulate that far exceeds this level by 7-50 times. Within the radius of our surface sample exists the potential bare skin of the patients face, oral mucosa, chest, and neck as well as the dental workers hands, wrists, arms, and neck. Contamination with mercury particulate of clothing worn by the team during an eight hour work day constitutes a significant chronic exposure to mercury.

The following recommendations are currently taught by the IAOMT to members to reduce mercury exposure for the patient and the dental team:

1. Use nitrile dam material and gloves at all times when removing silver mercury fillings. The routine use of a rubber dam has repeatedly been shown to reduce exposure of the patient and the operator to mercury vapor when drilling amalgam in humans (Nimmo et al. 1990, Berglund et al. 1996).
2. Always use a high volume of water and suction, while removing silver mercury fillings, and remove in as large chunks as possible.
3. Provide the patient oxygen or air with a delivery system that covers the nose of the patient to prevent inhalation
4. Place a saliva ejector under the dam to reduce vapor exposure to the patient.
3. Use engineering controls, Tact-air, clean-up, high volume auxiliary suctions designed to filter mercury particulate and mercury vapor.
4. The dentist and any team member present should wear a respirator type mask equipped with a mercury vapor and mercury particulate filter.
5. HgX cream (Acton Industries) should be applied to all exposed skin surfaces.
6. Use whole room filtration systems with activated charcoal filters to maintain air quality.

The data in this study indicates that additional measures also need to be taken to protect exposed skin and clothing for the dentist, assistant, and patient to prevent contact with mercury vapor and mercury particulate. This contact may be a sub acute, low level of chronic mercury exposure, when all recommended engineering controls are in place with the potential for high peak exposures to mercury vapor and mercury particulate. The Alberta Occupational Health and Safety manual states “an employer must ensure that a worker’s skin is protected from a harmful substance that may injure the skin on contact or may adversely affect a worker’s health if it is absorbed through the skin. The data obtained in this study, especially the exposure to mercury particulate, indicates additions to the IAOMT recommended protocol should be considered: Appendix A explains the recommended additions.

CONCLUSION
Dentists that practice with no engineering controls in place are at risk of exposure to mercury vapor and particulate by inhalation, accumulation on clothing, and absorption through exposed skin. Dentists and assistants following the current recommended IAOMT engineering protocols are protected from inhaling mercury vapor and mercury particulate, but are still exposed to accumulation of particulate on clothing and absorption of mercury vapor through their skin. Dentists and assistants should consider the use of full coverage barrier protection with disposable coveralls and the utilization of mercury vapor masks with full face protection to protect against contamination from particulate. Further research will be required before the ideal material for barrier protection can be determined.

Scientific Literature:
The data in this study indicates that additional measures also need to be taken to protect exposed skin and clothing for the dentist, assistant, and patient to prevent contact with mercury vapor and mercury particulate. This contact may be a sub acute, low level of chronic mercury exposure, when all recommended engineering controls are in place with the potential for high peak exposures to mercury vapor and mercury particulate. The Alberta Occupational Health and Safety manual states “an employer must ensure that a worker’s skin is protected from a harmful substance that may injure the skin on contact or may adversely affect a worker’s health if it is absorbed through the skin. The data obtained in this study, especially the exposure to mercury particulate, indicates additions to the IAOMT recommended protocol should be considered: Appendix A explains the recommended additions.

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Journal Prosthetic Dentistry, 1990 Feb 63(2):228-33 Particulate Inhalation During the Removal of Amalgam Restorations Nimmo A, Werley MS, Martin JS, Tansy MT, Department of Prosthodontics, Temple University School of Dentistry, Philadelphia, Pa

Human and Ecological Risk Assessment, Inhalation of Hg Contaminated Particulate Matter by Dentists: An Overlooked Occupational Risk, Oct 1, 2003 Richardson, G. Mark

Legal Aspects of this Scientific Review: A member in the IAOMT should do all that is necessary to protect the patient and team members from exposure to all forms of mercury. OSHA and Health Canada require that employees be informed of any possible workplace hazards and when hazards are present they have to be trained and provided with necessary protective equipment. Providing training, respirators for mercury vapor and particulate, and protective garments for exposure to mercury particulate would be a beginning to meet OSHA and Health Canada standards.
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## Mercury Vapor Protection - Under Latex Gloves

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**Explanation of IAOMT position:** This SR is intended as a framework through which a comprehensive and organized Anti-Toxic Program may be developed to clarify and define this difficult medical and dental discipline. As such, this SOC should be a living, changing document, as new information is available.

### Name of Scientific Review: Mercury Vapor Exposure - Under Latex Gloves

### Alternative name(s) of Scientific Review: n/a

### This Scientific Review is related to: Dentistry

### This Scientific Review is a: Procedure

### Purpose of the Scientific Review: Minimize Mercury Vapor Exposure thru skin

### Scientific Review History: None

### A brief description of the Scientific Review: The portal of entry for mercury vapor of most concern is inhalation thru the lungs. Dentist & staff also will absorb vapors under latex gloves thru the skin. Here is an option for protection

### A specific description of this Scientific Review:
- Mix flour of sulfur (1 tsp) into about 8 oz. of hand lotion
- Put on 1 pair of gloves to which this mixed hand lotion is applied
- Then double glove
- Dispose immediately after removal and dispose of outside
- Re-glove normally
- Rubber dam may be done also in same fashion

### Manufacturer(s): Made in office (be careful with perfumed hand lotions & sensitive patients)

### Scientific Literature: Sulfur bonds with mercury, latex gloves and dam allow mercury vapor to pass thru it and also absorbs the mercury which it emits later (moments)

### Legal Aspects of this Scientific Review: None

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### Nitrile Gloves – A Barrier to Mercury Vapor

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#### Explanation of IAOMT position:
Excellent to use in place of Latex Gloves

#### Name of Scientific Review:
Nitrile Gloves – A Barrier to Mercury Vapor

#### Alternative name(s) of Scientific Review:
N/a

#### This Scientific Review is related to:
Dentistry

#### This Scientific Review is a:
Procedure

#### Purpose of the Scientific Review:
Mercury hygiene and safety

#### Scientific Review History:
None

#### A brief description of the Scientific Review:
A method has been described using double gloved latex (which is porous to mercury vapor) and sulfur. This procedure describes using nitrile which appears to be impervious to mercury vapor.

#### A specific description of this Scientific Review:
Experiments were performed to test the porosity to mercury vapor of three dental barrier materials: 1. latex 2. nitrile 3.a latex substitute (unknown composition). Author has series of photos of the following.

- The mercury was placed in a glass cup
- The barrier was placed over the top to seal the mercury from escaping
- Cup was placed in 100+ degree water to heat and increase the mercury vapor pressure on the test barrier thus simulating glove wearing temperature. The material was stretched to simulate actual stretching when material was in use.
- Measurements were performed with a Jerome Mercury Analyzer, drawing air samples from over the surface of the barriers
- Measurements were repeated until the water cooled

Results: Latex and latex substitute consistently tested positive for mercury vapor. Nitrile consistently tested negative for mercury vapor!

Conclusion: Nitrile gloves are suggested as a method of better mercury hygiene than latex!

#### Manufacturer(s):
Many

#### Scientific Literature:
None

#### Applicant Name:
Grant H. Layton, DDS, AIAOMT

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#### Home FAX:
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#### Zip code:
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#### e-mail:
grant@grantlaytondental.com

#### IAOMT Member #:
491

#### IAOMT Chapter:
North American
Oral Evacuator Isolate Attachment
Clean Up

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**Biological Support**

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**Explanation of IAOMT position:** This is one of the key steps in the SR’s: “Reducing Mercury Vapor Exposure to the Patient During Amalgam Removal” and “Reducing Mercury Vapor Exposure for Doctor and Staff During Amalgam Removal.”

**Name of Scientific Review:** Oral Evacuator Isolate Attachment

**Alternative name(s) of Scientific Review:** Clean Up

**This Scientific Review is related to:** Dentistry

**This Scientific Review is a:** Product & Procedure

**Purpose of the Scientific Review:** Minimize mercury exposure while removing amalgam fillings for the patient, doctor & staff

**Scientific Review History:**
- Used in Sweden 1-2 years prior to U.S introduction in 1993
- Approved for Canada distribution March 1993
- Approved for USA distribution by USFDA on June 6, 1993

**A brief description of the Scientific Review:** Specialized high volume evacuation for operative procedures on posterior teeth. Disposable “nozzle” fits around operative tooth and attaches to autoclavable (250°F) custom handle. HVE is directed to immediate operative area significantly reducing mercury vapor and particulate splatter during mercury amalgam removal.

**A specific description of this Scientific Review:** Place swivel around tooth in immediate operative area during operative procedure (removal of old fillings and tooth preparation). Maintain evacuation until custom handle is replaced with conventional handle for routine evacuation.

**Manufacturer(s):** CleanDent Sweden AB, Keltstravgatan 3, SE-79432 Orsa, Sweden, [www.cleandent.com](http://www.cleandent.com) (see web page)

**Distributor:** IAOMT 8297 ChampionsGate Blvd, ChampionsGate, FL 33896 863-420-6373

**Scientific Literature:** Unpublished data from Uppsala Medical Center in Sweden demonstrates 100 fold reduction in exposure to mercury vapor generated during amalgam removal compared to removal with conventional HVE.

**Legal Aspects of this Scientific Review:** Legal Aspects: Positive:
- unit protects tongue and check from drill during operation
- patient/staff reduction of exposure to mercury vapor, amalgam particulate, and other toxics
- Patient / staff reduction of exposure to infectious aerosol/particulate

**Applicant Name:** Michael Ziff, DDS, Update by Phillip P. Sukel, DDS

**Office Phone:** 847-659-8500

**Mailing Address:** 11952 Oak Creek Parkway

**Office FAX:** 847-659-8585

**City:** Huntley

**Home Phone:** 847-515-3122

**State:** IL

**Home FAX:** 847-515-3123

**Zip Code:** 60142

**Country:** USA

**e-mail:** mercuryfree@sbcglobal.net

**IAOMT Member #:** 022

**IAOMT Chapter:** North American
**Oral Methionine for nitrous oxide protection, increased wound healing & protection from potential metal exposure during amalgam removal procedures**

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**Explanation of IAOMT position:** none

**Name of Scientific Review:** Oral Methionine for nitrous oxide protection, increased wound healing & protection from potential metal exposure during amalgam removal procedures

**Alternative name(s) of Scientific Review:** Sulfhydral protection of nitrous oxide blockage of Methionine remethylation for dental patients and dental personnel exposed to nitrous oxide during dental procedures, with provisional addition of protection from toxic metal exposure to patients and dental personnel

**This Scientific Review is related to:** Dentistry

**This Scientific Review is a Product:** Redoxal HMF

**Purpose of the Scientific Review:** To prevent deficiency of Methionine from the use of exposure to nitrous oxide and to provide additional Sulfhydral proteins to patients and personnel exposed to toxic metals.

**Scientific Review History:** The discovery of the effect of nitrous oxide on Methionine levels is recent. Tablets combining dl-Methionine with betaine have been used successfully by many persons for a variety of inflammatory conditions and alleviation of pain. Methionine has a long history of safety and is being evaluated by many researchers for its effect in a variety of disease states as well as being used by clinicians for antioxidant properties, the healing of tissues and its many beneficial applications in common western diseases. It is commonly known that sulfhydral bind to toxic metals and promote excretion.

**A brief description of the Scientific Review:** Administration of Methionine with betaine will compensate for blockage of the remethylation of Methionine from nitrous oxide and will provide additional Sulfhydral proteins for toxic metal binding for patients and dental personnel.

**A specific description of this Scientific Review:**

**Suggested Uses:** Specific for Redoxal HMF

**IAOMT - SOC Updated 6/2000**

**Doctors Guide to Redoxal HMF™ Suggested Usages**

**Conditions:**
Redoxal HMF has been used for inflammatory conditions; headaches including migraines; asthma; as an aid to detoxification from metals, pesticides, herbicides, drugs, alcohol, chemical exposures, radiation exposure; support for cysteine production for persons on chelating drugs; depression. Refer to our literature for a more complete list of uses.

**Amalgam Removal:** Preferred Use: Start Redoxal HMF at least 2 weeks prior to the first amalgam removal and continue for at least 6 months after last amalgam is removed. Dose is 1 capsule 3 times per day or according to weight chart for persons of normal weight. For persons 20% over ideal weight (according to body fat measurement) the suggested daily dose of Redoxal HMF is 2 capsules 3 times a day.

**Nitrous Oxide Gas Use:** Day Before Use (Patient): 1 capsule three times per day with meals the day before, the day of and the day after exposure to nitrous. Day of Use (Patient): (No prior ingestion of Redoxal)
2 capsules prior to administration of nitrous and 1 at conclusion of use. For frequent exposure (dental personnel) 1 capsule 3 times a day is suggested.

**Wound Healing: Accidental or Surgical**

**Accidental wounding:** (Includes cuts, scrapes, burns, etc) Start Redoxal according to amalgam removal directions and continue for 30 days or until wound is healed.

**Surgical wound:** Start Redoxal at least 1 week prior to scheduled surgery and continue for 30 days or until surgical site is healed. *Keep in mind that dl-methionine reduces inflammation and enhances the effects of pain medication. Patients taking Redoxal HMF may not require full doses of prescribed pain medication post surgically or after tooth extraction / oral surgery.*

**Personnel with continuous exposure to potentially toxic substances:**

**Suggested Use:**
1 capsule 3 times per day for duration of exposure or according to weight chart for duration of exposure. If overweight dose is 2 caps 3 times per day. Continue for at least 6 months after exposure is eliminated.

<table>
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<tr>
<td>61-120</td>
<td>2</td>
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Redoxal HMF may be taken for extended periods of time.

*d-methionine raises blood levels of methionine for approximately 4 hours. Spacing doses is important to maintain adequate levels of methionine in the blood. Taking Redoxal with food is not mandatory. It can also be taken on an empty stomach if patient so desires.*

**NOTES:**
1. If patient regularly takes non-steroidal anti-inflammatory meds, consider starting their dose at 2 caps three times per day. Non-steroidal medications require cysteine for excretion and these people are often sulfur protein deficient. Chelating agents (DMSA) also bind to cysteine for excretion. (Cysteine is a metabolite of methionine) Persons with confirmed low methionine levels (as determined by blood test) should also start at the higher dose for duration of 2-4 weeks. Persons over 60 generally require up to 2500 mg/day of methionine (according to the literature).

2. Individuals diagnosed as mercury toxic or allergic and considered to be fragile: suggest starting Redoxal HMF 30-60 days prior to first quadrant removal. Initial dose may need to be decreased, starting with 1 capsule per day and gradually increasing to higher doses as detox tolerance increases.

3. Redoxal may be taken with prescription chelating agents (oral) and all chelation therapy programs (IV & IM).

4. Persons who are 10% or more over ideal body weight require an increased dose of Redoxal in order to mobilize and excrete the same amount of Hg as those persons on 3 caps per day who are of normal weight.

**THIS INFORMATION PROVIDED TO PROFESSIONALS ONLY - FOR ASSISTANCE OR QUESTIONS, CONTACT**

PREVENTHIUM INTERNATIONAL  770-831-8605  Monday – Thursday  10AM – 3Pm EST
**Manufacturer(s):** A single capsule or caplet containing both dl-Methionine and betaine together with appropriate vitamins and minerals (manufactured by Preventium International, Inc., Sugar Hill, GA.) as Redoxal HMF and is available to professionals from McGuff Medical Products in Santa Ana, CA 800-854-7220 or in Canada from San Total Health Pharmacy, Markhan, Ontario 888-993-3666. Otherwise, there are many manufacturer’s of Methionine.

You may recommend any Methionine tablet of 500 mg dl-Methionine 3 times per day plus 50 - 100 mg betaine 3 times per day and 2 multiple vitamin/mineral tablets, 1 two times per day, containing at least 100% of the Recommended Daily Allowance of vitamins B6, B12, folate, calcium and magnesium.

There is a commercially produced product containing 500 mg dl-Methionine with the stated vitamins and minerals marketed as Mythionine for RELIEF by Tech-Transfer. Patient would need to take separate betaine tablet containing at least 50 mg of betaine.

Vitamin B6, folate and betaine all promote the conversion of homocysteine back to Methionine. The benefit of the Redoxal product is that it contains all of these co-nutrients. Early data on a small group of subjects indicated that the Redoxal HMF product assisted in the lowering of cholesterol and triglycerides in some people without any dietary changes. This data has not been published.

**Scientific Literature:** It has been shown in humans that nitrous oxide blocks the enzyme Methionine synthase. In 2 patients on high doses of nitrous oxide, the blood levels of Methionine were reduced [1] This reduction of blood level is especially important because even a week long total block of dietary Methionine intake did not result in a lowering of the blood level of Methionine. At high doses of nitrous oxide, the blockage of Methionine remethylation caused a reduction of leukemic cells in one of two patients treated. The implication of this observation is that nitrous oxide is a strong blocking agent of the normal movement of methyl groups. Providing methyl groups directly from Methionine should reduce unwanted side effects caused by the blocking of Methionine synthase from nitrous oxide, especially for dental personnel who may be exposed on a regular basis. Betaine remethylates homocysteine to Methionine in the liver by a separate enzyme, by providing Methionine and betaine together, the body’s need for methyl groups is met despite the blockage of remethylation using the vitamin B12-folate pathway.

Lack of betaine causes an elevation in homocysteine. Elevated homocysteine has been cited multiple times in the literature and media reports as an increased risk factor for stroke and heart attack, independent of cholesterol and other lipids [2].

As an additional benefit of Methionine, consumption of / exposure to heavy metals may be more readily excreted in the feces. It has been shown in lead toxic rats treated with Methionine that lead excretion in feces was significantly higher in the Methionine treated rats [3]. Methionine may provide some additional benefit / protection during amalgam removal due to its indirect contribution to glutathione synthesis and by providing additional sulfhydrals that are known to bind toxic metals [4]. Increased Methionine in the diet of rats improved weight gain when the rats were treated with toxic doses (1.5 ppm) of methyl mercury [5].

Reports in the Literature site dl-methionine’s role in the healing of wounds, both accidental and surgical [6],[7].

Nitrous Oxide can cause headaches post use. This may be a direct effect of Methionine lowering from this gas. Supplementation with Methionine pre and post nitrous use may prevent this reaction. Daily supplementation with Methionine may offer some protection from daily nitrous exposures of dental personnel in practices were this gas is used frequently.

Clinical studies in humans are currently in progress to evaluate methionine’s effect on mobilization of several toxic metals, including mercury. No data has yet been published from these studies.

**Legal Aspects of this Scientific Review:** dl-Methionine, betaine, vitamins and minerals are nutritional over the counter components of many supplements. Current U.S. law allows the sale of such nutritional products and for the separate display of information about such nutritional supplements. Di-Methionine has one of the longest and best safety records of any nutritional supplement. For many years soy-protein based infant fromula contained dl-Methionine to replace the Methionine to replace the Methionine lost during the extraction of the soy protein. No adverse effects have been reported for infants that consumed a majority of their calories from such infant formula. The body dose for such infants is equivalent to about 7 grams of dl-Methionine for adults [8]. Most pet foods for dogs and cats contain Methionine. No adverse effects have been reported in animal use. dl-Methionine does increase urinary calcium loss at 6 grams per day. The addition of calcium in the two commercially available products compensates for the calcium loss.

**Additional Reading and References:**
2. “Good Health with dl-methionine” by Gerald Hirsch, Ph.D. ($3.95).
These publications available from:

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<tr>
<td>Mailing Address: Preventhium, 5885 Cumming Highway Ste 108-291</td>
<td>Office FAX: 770 831-8610</td>
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<tr>
<td>City: Sugar Hill</td>
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<td>IAOMT Member #: through Ron Dressler, DDS, # 003</td>
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[1] “Regulation of Methionine Metabolism: Effects of Nitrous Oxide and Excess Dietary Methionine;” Michael S Frontiera, Sally P. Stabler, J. Fred Kohlhouse, and Robert H. Allen; Department of Medicine and Department of Biochemistry, Biophysics and Genetics, University of Colorado Health Sciences Center, Denver, CO, USA, Journal of Nutritional Biochemistry, 1994, vol. 5 January


Physical Barriers to Reduce Mercury Exposure During Amalgam Removal

Explanation of IAOMT position: This is an update and addition to: Patient Protection During Mercury Amalgam Removal

Name of Scientific Review: Physical Barriers To Reduce Mercury Exposure During Amalgam Removal.

Alternative name(s) of Scientific Review: Reducing Patient Hg exposure.

This Scientific Review related to both Medicine and Dentistry.

This Scientific Review is a procedure.

Purpose of the Scientific Review:
Since many individuals seeking amalgam replacement are medically compromised, the following procedures are essential to protect the patient against inadvertent mercury exposure. For such individuals, all the described procedures are deemed necessary. For medically less compromised subjects, fewer protective procedures may be employed, at the discretion of the attending dentist. However, it is recommended that all procedures be used wherever possible.

Scientific Review History:
Many patients report adverse reactions following amalgam removal. In the medically compromised individual or the metal sensitive individual, even small amounts of amalgam exposure can cause adverse reactions.

Briefly describe the Scientific Review:
This Scientific Review covers the essential protective procedures that could be employed in the healthy and medically compromised patient. The medically compromised patient presents a significant therapeutic challenge. For example, medical histories of allergies or Multiple Sclerosis (or other autoimmune diseases), neurological diseases, kidney diseases, cardiovascular diseases, respiratory diseases, and Psychiatric disorders may be more vulnerable to the toxic effects of even low doses of mercury. Special attention must be employed to minimize mercury exposure in these medically people compromised.

Specifically, describe the Scientific Review:

1. Activated charcoal
   Approximately 15-30 minutes before amalgam removal, the patient should take a charcoal caplet. This supplement will bind some of the minute amalgam particles that may be inadvertently swallowed during the drilling procedure. A second caplet should be taken at the end of the appointment. Thereafter, activated charcoal should be avoided because it can also absorb certain good nutrients and medications. Activated charcoal has been used as a medical aid for stomach upset and food poisoning. It is also used in some hospitals for serious poisoning cases. Since the material is an over-the-counter medication, with low incidence of side effects, its usage does not appear to present a problem. Also see Scientific Review on Pre-amalgam Removal-Activated Charcoal Slurry rinse and Swallow.

2. Room fans for ventilation
   An excellent method to protect the patient is to have a small fan placed on the left, behind the patient (if the dentist is left-handed place it on the right) that will blow a stream of air across the patient towards their feet. Any vapors or particulate material are kept out of the breathing zone. This is standard procedure in Occupational Health and Safely.

3. Eye protection
The eye is very sensitive and delicate and should be protected from exposure to mercury particles. Dental tooth surgery always produces an aerosol of vapor, fluid droplets and tooth and/or filling particles. It is just good practice to protect the patient’s eyes with goggles when undertaking any tooth drilling, because mercury vapor is very lipid soluble and can readily cross skin and membranes. This protection will also eliminate the possibility of physical damage to the eye that could result from trauma of filling material falling in the eye, and protect the sensitive eye from allergic or local toxic reactions.

4. **Protective coverings**
   The use of a large plastic drape over the patient is also recommended. This protects the patient from immediate exposure to filling particles on the skin and minimizes the absorption of mercury through the skin since mercury vapor is can readily pass across tissues. It also ensures that the clothes do not collect mercury-filling dust, which would be trans-ported to the home and act as an exposure to infants, if picked up by the patient.

   Cloth drapes must be placed over the face, to protect against absorption through the facial skin. It also minimizes the collection of particles in the hair of the scalp or face.

5. **Rubber dam**
   Rubber dam is a thin sheet of rubber that is placed in the mouth over the teeth with only the tops of the teeth protruding through.

   **Advantages**
   A. A dry working field is maintained for the dentist because the rubber holds back the saliva.
   B. The rubber dam protects the patient from possible inadvertent injury from the high-speed drill and ensures that foreign objects are not swallowed.
   C. The dentist is also protected, since saliva and body fluids are held back, reducing the potential for infection.
   D. The rubber dam does not allow the drilled particles of the removed mercury filling to be swallowed, nor does mercury vapor diffuse across the oral tissues into the bloodstream.

   **Disadvantages**
   A. Those few individuals who may be allergic to the latex or corn starch in or on the dam material. Here non-latex dams should be employed.
   B. Some circumstances are difficult, if not impossible, for rubber dam use, due to tooth location or size for the clamp.
   C. Mercury vapor passes through latex instantly so a working saliva ejector is necessary to remove the vapor (be certain the patient doesn’t stop it with their tongue)
   D. Rubber dam takes extra time to place, but it is the safest way to do dental treatment.
E. Some find the rubber dam uncomfortable or claustrophobic. These personal difficulties should be discussed thoroughly with the patient.

F. Possible fracture of tooth and damage to hard and soft tissues during clamp placement and removal

Mercury vapor passes through the rubber dam. This can be minimized by applying a sulfur mixture to the underside of the dam.¹

**A specific description of this Scientific Review:** Mercury Vapor Exposure - Under Latex Gloves

- Mix flour of sulfur (1 tsp.) into about 8 oz. of hand lotion
- Apply the paste to the surface of the outside surface of the rubber dam
- Immediately after amalgam removal is complete, dispose of the dam and replace with a new un-coated dam for restorative procedures.

6. **Alternate source of breathing air**

Since during removal of the filling some mercury vaporizes, an alternate source of breathing air is essential for the medically compromised or suspected mercury sensitive patient. Compressed medical air delivered to the patient through either a nosepiece or nasal canula is the best method. This ensures that the risk to breathing the mercury vapor and dust is reduced. This protocol will significantly reduce the incidence of unwanted side affects.² If compressed medical air is not available; then move the end of the mask hose away from the patient. The hose placement should not be on the floor.

7. **A suction device CLEAN-UP™**

This device, designed in Sweden and available through the IAOMT, slips over the tooth to be treated and will suction away considerably more mercury vapor and particles than the usual dental suction devices. Highly recommended. See Scientific Review Oral Evacuator Isolate Attachment.
8. **High pressure drills**
   Using the 90-psi drill, the dentist should section the mercury fillings. By sectioning the mercury filling, less drilling time is necessary and therefore less mercury vapor is produced.

9. **High volume suction**
   Most dental offices are equipped with high volume intra-oral suction. Sometimes, due to the large amount of water recommended, one vacuum tip is not sufficient. Some dentists will employ two such vacuums. The vacuum removes the water and particles, but also helps to reduce the mercury vapor and particle exposure.²

   Extra oral vacuums are also recommended. A chair side air cleaner that captures odors and vapors in the dental operatory that escapes from the patient's oral cavity notably during the mercury removal process in order to protect the patient and staff. This vapor is odorless and invisible and therefore very insidious. Devices sold with air abrasion technology have proven useful during amalgam removal procedures. See Scientific Reviews on IQ Air and DentAir Vac.

   The final patient protection looks like the following picture.

---

**New Additions to this document.**
1. Room fans
2. Patient body drapes
3. Patient face protection
4. Eye protection
5. Extra high speed hand pieces
6. Extra-oral vacuums

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**Manufacturer(s):**
1. Practicon Inc. 
   Protective face coverings
2. IAOMT 
   Clean-up
3. Dentairvac or SmartAir Solutions 
   Extra-oral suction
4. Any Health Food Store 
   Activated charcoal
5. Any Safety Supply Co. 
   Protective glasses

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**Scientific Literature:**

**Legal Aspects of this Scientific Review:**
No legal precedents at this time. However, in the future it may be considered malpractice not to take such precautions, especially with the medically compromised patient.

<table>
<thead>
<tr>
<th>Applicant Name: Murray J. Vimy, BA, DMD, FAGD, MIAOMT</th>
<th>Office Phone: Retired</th>
</tr>
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<tbody>
<tr>
<td>Mailing Address:</td>
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</tr>
<tr>
<td>City: Calgary</td>
<td>Home Phone: 403-240-2101</td>
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The IAOMT and Mankind Thanks You!
Positive Pressure Fresh Air Source for Amalgam Removal

**Explanation of IAOMT position:** Good science supports minimizing mercury vapor exposure. This is a good inexpensive method especially if it can be outside air.

**Name of Scientific Review:** Positive Pressure Fresh Air Source for Amalgam Removal

**Alternative name(s) of Scientific Review:** Dilution of Mercury Vapor During Inhalation When Removing Amalgams

**What is this Scientific Review related to?** Dentistry

**Is this Scientific Review a ...?** Procedure & Equipment

**Purpose of the Scientific Review:** Decrease the patient exposure to mercury vapor during amalgam removal by dilution with additional fresh air directly in the nose by positive pressure.

**Do you have a vested financial interest in any part of this Scientific Review?** no

**Scientific Review History:** When amalgams are being removed mercury is released and inhaled by the patient. Since this exposure to the mercury toxin is a hazard to the patient’s health, the IAOMT has always suggested minimizing such exposures.

**Specifically, by outline if appropriate, describe the Scientific Review:** A fish tank air pump is mounted outside the treatment room (preferably outside the building) where by relatively fresh air is pumped in through plastic tubing to a disposable nitrous oxide nose piece. A facemask (disposable) is placed over the nosepiece. When air is pumped into the nosepiece, mercury vapor cannot enter and the patient breathes only fresh air.

**Manufacturer(s), distributor(s), or publisher:**
- Profile Aquarium Air Pump, International Pert Supplies, San Diego, CA, 92121
- Nasal Hood by Accutron, 2020 Melinda Lane, Phoenix, AZ, 83027, 1-800-531-2221
- Other brands and manufacturers will also do

**Scientific Literature:**
- Ziff, Michael, Mercury 102, Mercury Vapor Absorption in Humans, IAOMT Accreditation Tape #1

**Legal Aspects of this Scientific Review:** Positive: by decreasing the patient’s breathing of the mercury vapor rich air during the process of mercury amalgam removal.

**Applicant Name:** David E.S. Mercer, DDS, AIAOMT

**Office Phone:** Retired

**Mailing Address:**

**City:**

**State of Province:** CA

**Country:** USA

**Zip code:**

**Home Phone:**

**Home FAX:**

**e-mail:**
# Reducing Mercury Vapor in the Operatory Common Breathing Space by Ion Precipitation

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<tr>
<td><strong>Alternative name(s) of Scientific Review:</strong></td>
<td>Electrostatic Precipitation of Mercury Vapor</td>
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<td><strong>This Scientific Review is related to:</strong></td>
<td>Dentistry</td>
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<tr>
<td><strong>This Scientific Review is a:</strong></td>
<td>Procedure &amp; Equipment</td>
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</tbody>
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| **Purpose of the Scientific Review:** | To reduce concentrations of mercury vapor in the operatory common breathing space during amalgam removal |

<table>
<thead>
<tr>
<th><strong>Scientific Review History:</strong></th>
<th>IAOMT lists approved protocols for Standards of Care Procedures for:</th>
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<tbody>
<tr>
<td></td>
<td>• Reducing Mercury Vapor Exposure for the Patient During Amalgam Removal (Ziff 2/14/96)</td>
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<tr>
<td></td>
<td>• Reducing Mercury Vapor Exposure for Doctor &amp; Staff During Amalgam Removal (Ziff 2/14/96)</td>
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<tr>
<td></td>
<td>• Reducing Mercury Vapor Exposure During Hygiene Procedures (Ziff 2/14/96)</td>
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| **A brief description of the Scientific Review:** | During amalgam removal, elevated levels of mercury vapor emanating from the patient’s mouth encounter a flow of negative ion’s which impart a negative charge to the mercury vapor molecules. A positively-charged collector plate located away from the patient area attracts and precipitates the mercury molecules which can then be collected on an alcohol wipe and safely disposed as bio-hazardous waste. |

| **A specific description of this Scientific Review:** | Mercury vapors not carried away by water flushing and high volume aspiration are released from the patient’s mouth during amalgam removal and certain hygiene procedures such as amalgam polishing. These vapors are in their highest concentration in the immediate breathing space common to the patient, dentist, and assistant. The Mercury Vapor Ionizer floods this common breathing space with a high volume negative ion field which encounters the mercury vapors as they are released into the breathing space. A strong negative ion charge is imparted to the vapor molecules which are then attracted to and precipitate on a positively charged collector plate positioned away from the common breathing area. The collector plate is cleaned weekly with an alcohol wipe which must be properly discarded with other medical waste materials. The negative ion generator, about the size of an electric toaster, is located on a shelf or counter top preferably at the head of the chair where the ion flow can be directed across the patient towards the food of the chair. A stainless steel collector plate is mounted on the wall near the foot of the chair and is connected to the positive post of the ion generator by a flexible cable which is easily concealed in ceiling and walls. Various standards exists with recommended mercury vapor exposure limits: a) for the general population (0.02 mcg mercury/m³); b) environmental atmosphere (0.3 mcg/m³); and c) work place acute exposures (0.3 mcg/m³). IAOMT data indicates levels as high as 1000 mcg/m³ can exists in breathing space during amalgam removal and from 500 to 900 mcg/m³ during dry polishing of amalgam fillings. These levels can be reduced to a range of 100 to 460 mcg/m³ with water cooling, approximately 110 mcg/m³ with water cooling and aspiration, and 15 to 40 mcg/m³ with water spray and high volume evacuation. These lowest levels are still 1000 times the USPHS standard of 0.02 mcg/m³, and the highest levels exceed it by 50,000 fold. The Mercury Vapor Ionizer generates approximately 2 billion ions per second and produces measurable ion levels of 20,000 ions per cubic centimeter at a distance of 5 feet from the ion generator (approximate distance to the common breathing space). As the negatively charged mercury molecules are drawn to the collector plate, the overall room air concentrations are held down to reduced levels. Following completion of amalgam removal, the collector plate continues to clear the air of molecules not captured by the first pass of ion flow. Residual concentrations are reduced to safe levels in 2 to 15 minutes compared to typically prolonged times approaching one hour for high concentrations encountered without ion precipitation. |

Unit 3 OPTIONAL IAOMT Accreditation Materials as of December 18, 2017; Page 43
**Scientific Literature:**

- From IAOMT approved Standards of Care
- **Doctor & Staff**
  - US Public health Service in “Toxicological Profile for Mercury” (USPHS, ATSDR, TP-93/10 May 1974) established its Minimal Risk Level (MRL) Standard for ‘acute inhalation exposure to metallic mercury vapour’ for the general population as 0.02 micrograms of mercury per cubic meter of air.
  - Richard & Warren during amalgam removal:
    - 1000 mcg/m³ without water cooling and aspiration
    - 100-460 mcg/m³ with water cooling and no aspiration
    - 110 mcg/m³ with water cooling and aspiration
- **During Hygiene**
  - IAOMT Data: During polishing amalgams with 3M disks:
    - 500 -900 mcg/m³ without water spray and high volume evacuation
    - 15-40 mcg/m³ with water spray and high volume evacuation

**Legal Aspects of this Scientific Review:** N/A yet

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Rubber Dam for Amalgam Removal

Explanation of IAOMT position: Physical barriers are important adjuncts during the removal of mercury fillings to reduce the dissemination, exposure and absorption of mercury and increase the ability of staff to evacuate particles and vapor. The use of a rubber dam as a Hg barrier has been an accepted technique for the IAOMT for 25+ years. This review provides some of the available scientific evidence for its use. It is important to note that use of a rubber dam is technique and practitioner sensitive and only one of several modalities that can be employed by a dentist during mercury removal. Improper use, including seepage, aspiration, trampoline effect, contamination and unevacuated mercury behind the rubber dam can increase a patient’s mercury exposure and absorption. Done correctly it can be an effective method to reduce potential exposure. This review is meant to provide some of the scientific basis for its use. We acknowledge that there are many modalities that can reduce patient exposure to mercury vapor and particulate and it is up to the clinician to use his/her best judgment in employing the most effective methods for each patient and their circumstances.

Name of Scientific Review: Rubber Dam for Amalgam Removal

Alternative name(s) of Scientific Review: Amalgam Removal with Rubber Dam, Use of rubber dam for amalgam removal

This Scientific Review is related to Dentistry

This Scientific Review is a Procedure

Purpose of the Scientific Review: Instruction on the proper use of a rubber dam during mercury removal and to provide the evidence for its use. In particular to identify the exposure of mercury vapor and particulate to a patient and staff during amalgam removal using an air rotor with and without a rubber dam.

Scientific Review History: The use of rubber dam has been an IAOMT accepted technique for the past 25+ years. Yet its effectiveness in reducing mercury exposure, either the vapor or particulate, to the patient has not been scientifically demonstrated.

Briefly describe the SR: Two studies published in peer reviewed journals show its use reduces exposure of operator and patient to mercury vapor while drilling out amalgams.

Specifically describe the SR: The operator places a rubber dam around the treated teeth before proceeding to remove amalgam restorations and removes it as soon as amalgams are out. Today a material similar to polyvinyl, nitrile, is preferred to a latex dam because mercury vapor crosses latex more easily than polyvinyl. Nitrile rubber dams would also be suitable but are difficult to source. (Personal communication with IAOMT researchers Drs David Warwick and Paul Rubin)

Manufacturer(s): Many

Scientific Literature:

Figure taken from Nimmo et al. demonstrates dentist and patient exposure with and without rubber dam and water during mercury removal.

Graph above shows patients having had amalgams removed without rubber dam are initially exposed to nearly twice as much mercury as those with a rubber dam protection. It also takes 300 days for their blood mercury plasma levels to reach the level of those benefiting from the original dam protection.

**Legal Aspects of this Scientific Review:** Dentists have a responsibility to limit mercury exposure to themselves, their patients and their staff while working with mercury amalgam.

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<td>IAOMT Member #:</td>
<td>IAOMT Chapter: NA</td>
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