

area since particulates generated by removing amalgams are dispersed in the environment. Beyond opening the window, other strategies for mercury removal include ultrafiltration and negative ion generators, plus basic vacuum force to remove the air from the operative field in the works room (*Dent-Air Vac, E. L. Foust, Smart-Air Solutions, and Tact-Air*). Finally, the routine use of oxygen while removing dental amalgam in the clinic is not easy since rules and Directive for its use are different in each country. In addition, simply moving into another space can be effective in reducing mercury exposure.

Mercury toxicity can be aggravated by the possible galvanic interaction between heavy metals due to metal ions release in mouth [29, 28]. The conventional dental filling is more prone to galvanic corrosion than the higher copper containing amalgam in contact with the Co Cr Mo alloy as well as titanium. These released heavy metals could be quelated by curcuminoides [30,21]. Thus, if too many amalgam restorations are present in the oral cavity or close implants are close to amalgams, the galvanic interactions will release ions constituting an additional factor contributing to mercury toxicity. In fact, the release of mercury from silver amalgam exposed to different bleaching agents (10 % carbamide peroxide) may also increase the toxicity of mercury. Since bleaching agents are often employed in cosmetic dentistry; we must also consider the possible interactions between them and increased mercury vapor levels during treatments and steam in these treatments [31]. Nowadays, there is an aesthetic demand in all fields of odontology [32]. For example, the exponential increases of multidisciplinary orthodontic treatments in adult patients together with great advances in the development of new materials have improved aesthetic and functional techniques such as micro-implants in orthodontics [33]. During these multidisciplinary aesthetic treatments, the safe protocols for dental filling removal are not always implemented in patients [31,2]. On the other hand, electronic magnetic contamination can also contribute to the noxious release of mercury from dental amalgam fillings in synergy with magnetic fields [34]. Finally, dentists must use a certified hazardous waste carrier to recycle and dispose of amalgam waste and develop combined strategies for preventing mercury vapor toxicity in odontology. Thus, the use of synergic nasal filters (active carbon) together with dietary supplements (*Curcuminoids, Desmodium, Clorella*, and other antioxidants) would increase patients' endogenous detoxification capacities helping prevent heavy metal toxicity.

Finally, since dental amalgam could be a risk factor for populations with mercury susceptibility, it is crucial to develop new precautions and rules even though certain cause-effect relationships have not been firmly established (UNEP. United Nations Environment Programme; Minamata); <http://www.unep.org/newscentre/default.aspx?> [37].

Interestingly, the Precautionary Principle states: "*The precautionary principle applies where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable*

grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU". This aspect of precaution must be followed by dentists, who could prevent irreversible environmental risks as well as toxicity of heavy metals in patients [35, 36, 37].

3. Conflict of Interest

None to declare. All authors declare that there is not conflict of interest

4. Figures



Figure 1: Nasal filters of Active Carbon



Figure 2: Safety protocol for dental amalgam extraction (patient and dentist)



Figure 3: The use of nitrile protection, glasses and nasal filter can prevent mercury contamination in patients (carbon active). His face was totally covered. This photo shows this nasal filter as alternative to the use of oxygen.



Figure 4 a, b. Nitrile plastic must be used before/after dental amalgam removal in patients.



Figure 5: a, b. Removal of dental amalgams by other safe and more biomaterial compatible.

References

- [1] Pigatto P.D., Minoia C., Ronchi A., Brambilla L., Ferrucci S.M., et al. Allergological and Toxicological aspects in a multiple chemical sensitivity cohort. *Oxid Med Cell Longev.* 356235, 2013.
- [2] Colson D.G. A safe protocol for amalgam removal. *J Environ Public Health* 517391. 18, 2012.
- [3] Geier D.A., Carmody T., Kern J.K., King P.G., Geier M.R. A significant relationship between mercury exposure from dental amalgams and urinary porphyrins: a further assessment of the Casa Pia children's dental amalgam trial. *Biometals.* 24(2): 215-24, 2011.
- [4] Mutter J., Is dental amalgam safe for humans? The opinion of the scientific committee of the European Commission. *Journal of Occupational Medicine and Toxicology* 6:2, 2011.
- [5] Zwicker J.D., Dutton D.J., Emery J.C., Longitudinal analysis of the association between removal of dental amalgam, urine mercury and 14 self-reported health symptoms. *Environ Health* 18;13:95, 2014.
- [6] Kao R.T., Dault S., Pichay T., Understanding the mercury reduction issue: the impact of mercury on the environment and human health. *J Calif Dent Assoc.* 32(7): 574-9, 2004.
- [7] Pamphlett R., Kum Jew S. Different Populations of Human Locus Coeruleus Neurons Contain Heavy Metals or Hyperphosphorylated Tau: Implications for Amyloid- β and Tau Pathology in Alzheimer's Disease. *J Alzheimers Dis.* 2014 Dec 29.
- [8] Edlich R.F., Greene J.A., Cochran A.A., Kelley A.R., Gubler K.D., Olson B.M., Hudson MA., Woode D.R., Long W.B. 3rd., McGregor W., Yoder C., Hopkins D.B., Saepoff J.P., Need for informed consent for dentists who use mercury amalgam restorative material as well as technical considerations in removal of dental amalgam restorations. *J. Environ Pathol Toxicol Oncol.*;26(4):305-22, 2007
- [9] Eley B.M., The future of dental amalgam: a review of the literature. Part 2: Mercury exposure in dental practice. *Br Dent J.* 26;182(8):293-7, 1997.
- [10] Lorscheider F.L., Vimy M.J., and Summers A.O., Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm." *The FASEB Journal* 9 (7), pp. 504–508, 1995.
- [11] Richardson G.M., Brecher R.W, Scobie H., Hamblen J., Samuelian J., Smith C. Mercury vapour Hg₀: Continuing toxicological uncertainties, and establishing a Canadian reference exposure level. *Regul Toxicol Pharmacol.* 53(1):32-8, 2009
- [12] Richardson G.M., Inhalation of mercury-contaminated particulate matter by dentists: an over looked occupational risk. *Hum Ecol Risk Assess* 9:1519-1531, 2003.

- [13] Richardson G. M., Wilson R., Allard D., Purtil C., Douma S., and Gravière J., Mercury exposure and risks from dental amalgam in the US population. post-2000, *The Science of the Total Environment*. 409 (20), pp. 4257–4268, 2011.
- [14] Clarkson T.W., Metal toxicity in the central nervous system. *Environmental Health Perspectives* 75, pp. 59–64, 1987.
- [15] Molin M., Bergman B., Marklund S.L., Schutz A., Skerfving S., Mercury selenium and glutathione peroxidase before and after amalgam removal in man, *Acta Odontol Scand*. 48 (3): 189-202, 1990.
- [16] Geijersstam E., Sandborgh-Englund G., Jonsson F., Ekstrand J., Mercury uptake and kinetics after ingestion of dental amalgam. *J Dent Res*. 80: 1793-1796, 2001.
- [17] Sjursen T. G. B. Lygre, K. Dalen et al., Changes in health complaints after removal of amalgam fillings. *Journal of Oral Rehabilitation* vol. 38, no. 11, pp. 835–848, 2011.
- [18] Kenney P., Hilberg O., Pedersen H., Nielsen O.B., Sigsgaard T., Nasal filters for the treatment of allergic rhinitis: a randomized, double-blind, placebo-controlled crossover clinical trial. *J. Allergy Clin Immunol* 133(5):1477-80, 1480.e1-13. Epub 2014 Feb 28, 2014.
- [19] Nylander M.L., Friberg., and Lind B., Mercury concentrations in the human brain and kidneys in relation to exposure from dental amalgam fillings. *Swedish Dental*. 11 (5), 179–187, 1987.
- [20] Torkmahalleh M.A., Yu C.H., Lin L., Fan Z., Swift J.L., Bonanno L., Rasmussen D.H., Holsen T.M., Hopke P.K., Improved atmospheric sampling of hexavalent chromium. *J. Air Waste Manag Assoc* 63 (11):1313-23, 2013.
- [21] Kukongviriyapan U., Pannangpetch P., Kukongviriyapan V., Donpunha W., Sompamit K., Surawattanawan P., Curcumin protects against cadmium-induced vascular dysfunction, hypertension and tissue cadmium accumulation in mice. *Nutrients* 21;6(3):1194-208. 2014.
- [22] Schmitz A.E., de Oliveira P.A., de Souza L.F., da Silva D.G., Danielski S., Santos D.B., de Almeida E.A., Prediger R.D., Fisher A., Farina M., Dafre A.L. Interaction of curcumin with manganese may compromise metal and neurotransmitter homeostasis in the hippocampus of young mice. *Biol Trace Elem Res* 158 (3):399-409, 2014.
- [23] Ngim Ch., Ngim A.D. Health and safety in the dental clinic – Hygiene regulations for use of elemental mercury in the protection of rights, safety and well-being of the patients, workers and the environment. *Singapore Dent J*. 34 (1):19-24. 2013.
- [24] Koral S.M., IAOMT Safe Removal of Amalgam Fillings, *International Academy of Oral Medicine & Toxicology* 2007.
- [25] Stonehouse C.A., Newman A.P., Mercury vapour release from a dental aspirator. *Brit Dental J*. 190:558-560, 2001.
- [26] Nimmo A., Werley M.S., Martin J.S., Tansy M.F., Particulate inhalation during the removal of amalgam restorations. *J Prosthet Dent*. 63 (2):228-33, 1990.
- [27] Berglund A., Molin M., Mercury levels in plasma and urine after removal of amalgam restorations: the effect of using rubber dams. *Dent Mater* 13:297-304, 1997.
- [28] Karam J.R., Rinchuse D.J., Dental amalgam corrosion in vacuum-formed retainers. *Orthodontics (Chic.) Spring*; 12 (1):70-4, 2011.
- [29] Unalan F., Aykor A., Bilhan H., The Galvanic Interaction Between a CoCrMo Alloy, Pure Titanium and Two Different Dental Amalgams with Special Attention on the Area Size. *The Open Corrosion Journal* 2, 17-25 17, 2009.
- [30] García-Niño W.R., Pedraza-Chaverrí J., Protective effect of curcumin against heavy metals-induced liver damage. *Food Chem Toxicol*. 69:182-201. Epub 2014 Apr 18, 2014.
- [31] Salomone P., Bueno R.P., Trindade R.F., Nascimento P.C., Pozzobon R.T., Assessment of the release of mercury from silver amalgam exposed to different 10% carbamide peroxide bleaching agents. *Gen Dent*. 61(1):33-5, 2013.
- [32] Sarver D.M., The importance of incisor positioning in the esthetic smile: the smile arc. *Am J. Orthod Dentofacial Orthop* Aug;120(2):98-111, 2001.
- [33] Park H.S., Bae S.M., Kyung H.M., Sung J.H., Simultaneous incisor retraction and distal molar movement with microimplant anchorage. *World J Orthod*. Summer 5 (2):164-71, 2004
- [34] Mortazavi S., Gholampour M., Haghani M., Mortazavi G., Mortazavi A. Electromagnetic Radiofrequency Radiation Emitted from GSM Mobile Phones Decreases the Accuracy of Home Blood Glucose Monitors. *J Biomed Phys Eng*. 1;4(3):111-6, 2014.
- [35] Chew C.L., Soh G., Lee A.S., Yeoh T.S. Long-term dissolution of mercury from a non-mercury-releasing amalgam. *Clin Prev Dent*. 13(3):5-7, 1991
- [36] "The Precautionary Principle". The Science and Environmental Health Network. January 2000. Retrieved October 25, 2008
- [37] UNEP (United Nations Environment Programme) (2013) Minamata Conventional greed by nations. United Nations Environment Programme. <http://www.unep.org/newscentre/default.aspx?DocumentID=2702&ArticleID=9373>. Accessed 26 Dec 2013.

Author Profile



Maria Eugenia Cabaña-Muñoz is Ph Candidate (Thesis doctoral in progress). "Effects of heavy metals in women that had dental amalgams for long period of time" Degree (Bsch) in Dentistry (University of Córdoba). Argentina 1989. Degree (Bsch) in Dentistry (University of Granada). Spain 1997, Degree in Orthodontics and Dentofacial Orthopedics (Paul Sabatier University). France 2001-2005. Researcher, Clinical Professor of the Master in Orthodontics and Dentofacial Orthopedics. Faculty of Medicine and Dentistry. University of Murcia, Spain. Teaching and Research. She was President of the First European Congress of Microimplants in Orthodontics (EUMIA; Murcia, Spain 2009). Expert in Cellular Nutrition and Health. University of Almería, Spain 2014. Postgraduate degree. Speaker at National and International Congresses on Microimplants in Orthodontics. Member of National and International Scientific Societies 25 years of experience (odontology) private practice in Murcia and Alicante (Spain).