Increased Mercury Release from Dental Amalgam Restorations after Exposure to Electromagnetic Fields as a Potential Hazard for Hypersensitive People and Pregnant Women

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Electricity is an essential part of modern life.
It is estimated that by the middle of this century, the global use of electricity will be multiplied by a factor of 2.5 to 3.0.

Electromagnetic fields (EMF) are produced by the motion of electrons.
All electrical or electronic devices such as wireless technologies (e.g. Wi-Fi, mobile phones and cordless phones), laptop computers, microwave ovens and power lines produce electromagnetic fields.

EMF Ocean!
We all live in an ocean of electromagnetic fields!

“Everyone is exposed to a complex mix of weak electric and magnetic fields, both at home and at work, from the generation and transmission of electricity, domestic appliances and industrial equipment, to telecommunications and broadcasting.”

- World Health Organization
A very basic question that should be answered: 
**Why is Exposure to Different Sources of EMFs so Important?**

Very Frequent Use by the Whole Population
- Wide Geographical Distribution of Users
- In Africa, no land-line but mobile phones are used
- Poor Knowledge about the Effects
- Inescapable Exposures

Very Wide Sources
- Baby Watch, Wireless Technologies
- Hidden Sources
- Wi-Fi Signals coming from our neighbors
- Continuous 24 h/d, 7 days/wk exposures
- Old Standards
- Challenging Serious Biological Effects
- The issue of exposure to Children

**Current Controversies**
- The effect of RF-EMF on biological systems is still controversial.

**Amalgam Mercury Issue**
- It was previously believed that dental amalgam, which contains about fifty percents mercury, is **inert** and cannot release mercury after restoration.
  - However, in 2009, the US FDA acknowledged that dental amalgam releases low levels of elemental mercury vapor.

**Dental Amalgam Safety Concern**
- Since 150 years ago, amalgam has been used in dentistry as an excellent and versatile dental restorative material due to its properties such as low cost, ease of application, strength, durability, and bacteriostatic effects.
  - However, nowadays, the popularity of amalgam is decreasing due to rapidly growing concerns about its detrimental health effects, environmental pollution, and aesthetics.
Now there is a growing public concern!

**Historical Changes of Mercury%**
- After some historical changes in the mercury-to-amalgam ratio, modern amalgams are now produced from precapsulated alloy consisting of 42-45% mercury by weight.

**ADA American Dental Association**
- America’s leading advocate for oral health

According to ADA:
- “Sometimes described as “silver-colored” fillings, dental amalgam has been used by dentists for more than 100 years!”

“Because of their durability, these silver-colored fillings are often the best choice for large cavities or those that occur in the back teeth where a lot of force is needed to chew.”

**More mercury than silver**
- Amalgam, the silver daily used in 90% of fillings, is 40% percent mercury. While the majority of dentists now use mercury-free composite fillings, many are concerned about possible mercury toxicity.

**Are low levels of mercury safe?**
- Recent findings indicate that mercury, even at low doses, may cause toxicity
- As dental amalgam fillings release low levels of elemental mercury vapor, today, there is a debate over:
  - If these levels are safe and
  - Whether the safety threshold is the same for different subpopulations.

**The rationale for our previous studies**
- Concerns regarding the rapidly growing exposure to EMF sources and increased mercury release from dental amalgam after exposure to electromagnetic fields, especially in children, people who are routinely exposed to electromagnetic fields and hypersensitive subpopulations, prompted us to perform more studies.
MRI and the Release of Mercury

Our first report on the role of exposure to magnetic resonance imaging (MRI) or microwave radiation emitted by mobile phones in enhancing the release of mercury from dental amalgam restoration was published in 2008.

Mobile Phone Use and the Release of Mercury

Table 2: The (mean±SE) urinary Hg concentrations of students with (test group) and without using mobile phone (controls) after dental amalgam restoration.

<table>
<thead>
<tr>
<th>Time</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>2.07±0.58</td>
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<tr>
<td>Test group</td>
<td>2.43±0.66</td>
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<tr>
<td>Student’s t-test</td>
<td>NS</td>
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</table>

Rationale for Our Recent Study

Nowadays, MRI systems utilize:
- Stronger static magnetic fields
- Faster and stronger gradient magnetic fields
- More powerful radiofrequency (RF) transmission coils

Methods in our recent study

To overcome the limitations of our previous study, we have recently studied the effects of stronger magnetic fields (1.5 T in our recent study vs. 0.25 T in our previous report) and provided further support for the adverse effect of MRI in increasing the release of mercury from dental amalgam fillings.

Results

Figure 1: Trends of urinary mercury concentration in the MRI exposed and unexposed group. Error bars represent SD.